REPORT OF THE DEFENSE SCIENCE BOARD
1979 SUMMER STUDY
ON
REDUCING THE UNIT COST OF EQUIPMENT

MARCH 1980

OFFICE OF THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING
WASHINGTON, D.C.

Report of the Defense Science Board

1979 Summer Study

on

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Office of the Under Secretary of Defense for Research and Engineering
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OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

DEFENSE SCIENCE
BOARD

January 14, 1980

Dr. Eugene G. Fubini
Chairman
Defense Science Board
Room 3D1034, The Pentagon
Washington, D.C. 20301

Dear Dr. Fubini:

You will find attached the final report of the 1979 Defense Science Board Summer Study Task Force on Reducing the Unit Cost of Equipment. As I review it for the last time, it appears to me that three of the major Task Force concerns deserve added emphasis.

1. Program Stability

   You will find throughout the report that stability of program elements, funding, and production rate are all emphasized as powerful influences on the cost of military equipment. Not as thoroughly explored, but also important, are the instabilities induced by inconsistent Program Manager authority and perturbations throughout a program induced by unplanned competition, changes from operational test programs, and sudden confrontations with "bow wave" affordability barriers. Specific suggestions are included to help DOD achieve a more stable development-production-deployment pattern.

2. Disciplining New Program Starts

   Although not addressed by this title, a number of the more important recommendations bear upon the reasoning which leads to new programs. These involve the requirements process, the adequate analysis of real needs, the ability to acquire valid future program cost estimates and the optimum utilization of the technology base without exceeding the affordability limits implicit in our budgetary process.

   Woven throughout the analysis is the conviction that we are too often driven to new systems because of the availability of advanced technologies and we do not assess the competing potential of performance improvements for existing systems, which benefit not only from specific technology but also from the low cost of an existing production base and from the military suitability, already proven.

3. The Costly Inertia of Military Procurement Management

Our total acquisition process from requirements to fielded systems has been beset by many political and monetary barriers throughout history and attempted acquisition solutions for each barrier have found their way into normal management with unspecified but major cost impacts. The Task Force has addressed a number of these problem areas and suggested solutions. It is emphasized in the report that these suggestions are, for the most part, not new. They have been essential conclusions of a number of previous studies. The different proposal of this Task Force is that the DOD use a few Task Force members as a follow-up team to help sell the concepts for cost saving, determine why the concepts were not usable, if rejected, and to seek more specific ideas by following DOD efforts to utilize the Task Force recommendations and initiatives.

We developed a series of other recommendations and four specific initiatives. Attached is a summary of the more significant of these recommendations and initiatives, and an indication of the agency or office which we believe should have implementation responsibility.

Not included in the final report is a simplified process —— a "slide rule" —— for determining when "competition" will provide a reduction in the unit cost of equipment. We hope, however, that the evaluation of past performance of "competition" programs and the concepts of how and where competition should benefit cost will be useful.

Finally, many capable and experienced people made thoughtful contributions to this study. This is most in evidence in the appendices where specific papers are included and a list of presentations is included. As the chairman of this Task Force, I must emphasize that the conclusions reached could not possibly encompass the total intelligence and dedication provided by the participants. I am grateful beyond expression for the privilege of working with such a team. We stand ready for the follow-up assignment which is suggested in the hope that some of this distilled experience will truly result in lower unit costs.

Sincerely,

Willis M. Hawkins

Willis M. Hawkins

ATTACHMENT 1

Subject Area	Recommendations and Initiatives	Responsible Office
Stability	Request OMB and the Congress to provide legislation requiring multi-year funding on production programs of more than $1 billion with duration that exceeds 3 years.	ASD(C)
	Each Service propose at least one program to test the concept of multi-year funding.	USDR&E* & Services
	Seek legislation to eliminate arbitrary restrictions on liability	DUSDRE (Acq. Policy)
	Seek change in legislation to increase reprogramming thresholds to 10% of line item value in R&D and 5% in procurement.	ASD(C)
	Establish management reserves for major programs.	USDR&E* & ASD(C)
Requirements/ Affordability	Establish Service PARE Teams (Program Affordability Requirements Evaluation) to audit military requirements for affordability.	USDR&E* & Services
Competition	As an experiment, select a program with long term production potential and place the "loser" of the FSED competition in a position of support to the winner. This will prepare the next best competitor to become the follower producer if such is required.	USDR&E
	Establish policy to require that a "Product Capability Improved" system be evaluated as a competitor to "new start" systems.	DUSDR&E (Acq. Policy)
Acquisition Management	Establish policy that provides the Program Manager with authority and and responsibility to: o Negotiate Charter o Tailor Directives o Develop Acquisition Strategy o Manage Program Reserves	DUSDR&E (Acq. Policy)

*Primary action

ATTACHMENT 1 - Continued

Subject Area	Recommendations and Initiatives	Responsible Office
Acquisition Management	Crucial to the success of this policy is the clear delegation of authority and the specific assignment of responsibility to the program manager to remove standard regulations and directives that do not enhance the value of the system for which he is responsible. This tailoring of the acquisition strategy to the program promises substantial cost savings.	DUSDR&E (Acq. Policy)
	Establish a "Defense Acquisition Cost Reduction Fund" to invest in creative unit cost reduction concepts.	USDR&E* & ASD(C)
	Each Service should identify one system which is planned for introduction into the inventory and combine warranty and service life policy with contractor furnished service, logistics, etc., to determine whether such support can decrease costs and improve readiness.	Services* & USDR&E
	Reassess the manufacturing technology program to increase effort for production methods improvements (productivity).	DUSDR&E* (R&AT) & Services
Product Capability Improvements	Establish advocacy for "Product Capability Improved" Systems at senior levels in OSD and the Services.	DUSDR&E* (Acq. Policy) & Services

*Primary action

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CONTENTS (Continued)

INTRODUCTION

The Summer Study Task Force of the Defense Science Board on Reducing Unit Cost of Equipment approached its assignment with full recognition that the subject of cost reduction in defense programs has hardly been ignored. Some members of the Task Force have participated in previous studies that directly or indirectly addressed this issue. Thus, a portion of the material contained in this report will be familiar, since it has been developed before in previous Defense Science Board studies. The problem of high unit costs, however, still exists and becomes more acute each day. New thoughts are presented but some previous recommendations have been repeated in the hope that the total will be more useful. The Task Force made a conscious effort not to write a management manual but to provide actionable recommendations.

The DOD faces a major unit cost problem generated in large part by the philosophy that increased performance can offset a quantitative disadvantage. The United States, through administrative and congressional actions, has accepted this numerical disadvantage by its successive compromises during the budgeting process. The Task Force did not address the performance vs. quantity issue directly but

certain of the recommendations suggest that requirements for performance may frequently be overstated in an effort to compensate for lack of quantitative equality.

The Task Force also did not specifically address Life Cycle Costs, but it was clearly an implicit constraint in developing recommendations and initiatives.

Requirements frequently appear to be driven by available technology rather than real need. It was the opinion of most members of the Task Force that if something technologically can be done, and this offers greater performance and flexibility, it will often be included in a requirement, without an evaluation of the real costs and worth of the achievement. The procurement and requirements process also appears to be driven by imputing a similar technology to potential adversaries, thus driving the United States to seek higher and higher performance with resultant greater expenditures.

The cost problem appears also to be exacerbated by Service competition for a rational share of the budget based on individual service views of responsibility for its future effectiveness in performing its mission. This places emphasis on the near term, with no reward for conservative estimates of future costs. If a program can get started long development times assure that ultimate inventory levels and production rates are not as subject to early fiscal constraints as would be a total Five-Year Program projection containing all the desired programs. Since the budget for

procurement is relatively fixed, it is spread over all projects instead of a selected few. Thus, fewer units than planned are procured. This results in changes in plans. Changes in plans cost money. With less money there will be fewer units. Thus the Services enter a self-defeating spiral of increasing costs, and fewer end articles.

The Task Force attempted to address not only the real problems of reducing unit costs but also the problem of a long developing environment that makes simple rational solutions difficult to introduce.

ORGANIZATION OF THE REPORT

Following the Executive Summary, this report contains the charts used in the summary presentation at Newport on August 8, 1979. Where necessary, further explanatory comments are included on the facing page. In several instances, the subject warrants a more detailed treatment. These are contained in the Appendices.

Because of time constraints, several subjects of importance were not included in the presentation at Newport. These subjects did receive substantial attention during the Summer Study. They are summarized in the section entitled "Other Conclusions and Recommendations."

Finally, there were subjects discussed during panel sessions and papers were developed, but no consensus was achieved concerning future Government actions. Since these papers are of merit, and may produce improvements they are included in the Appendices.

EXECUTIVE SUMMARY

The unit cost of defense equipment has been growing at such a rate that it has become difficult, if not impossible, to maintain current force levels. The Russian arms buildup has reached a magnitude such that we must increase the U.S. military effectiveness and the hardware inventory to the maximum possible extent. A fundamental premise of this evaluation is that the DOD procurement account will have only a modest increase in the next decade. With that basic assumption, there are four significant avenues open. These are to:

- Reduce unit costs on both new and existing systems,
- Increase the capability of current platforms, and major subsystems, where needed, to meet the changing threat,
- Reduce the number of new starts, buying more of current systems or
- Reduce the number of systems procured.

The last alternative, while unattractive, is the current practice. The Summer Study Task Force concentrated on the first two alternatives. A number of concepts were examined which showed promise of achieving cost reductions including more competition, use of commercial equipment, reducing the cost impact of current regulations, specifications and the acquisition process itself, and minimizing the dollar impact of the requirements process itself.

The study method was not unusual for a DSB effort. An experienced group was assembled from the Government, the systems analysis companies and industry. Many of those who participated are experienced from previous studies of the acquisition process, and most have major responsibilities in defense development and procurement. Since "cost reduction" is not new, an extensive data base was assembled and a number of pertinent briefings, based on past studies were presented. New data was developed during the study, but, in large part, the conclusions and recommendations are the distillation of the experience and judgment of the knowledgeable people assembled.

The Task Force's major conclusion was that, within limits, cost reductions can be accomplished, but such reductions will not solve the problem of adequately maintaining the current inventory. To maintain inventory with current projected procurement budgets would require an approximate 40% reduction in unit cost. Such reductions are not believed to be feasible.

PROGRAM STABILITY

Of the various changes that could result in unit cost reduction, the group concluded that the one which would have the most powerful impact is greater program stability. Current acquisition practices are characterized by less than "most economic" production rates dictated by the necessity to spread available funds over many ongoing programs. This less than optimum rate forces unit costs upward and a further reduction in total quantities to fit within annual procurement budgets. The budgeting process in the DOD is so tightly controlled that even a small change in one program will impact many others. Long term funding commitments to a program are essential to program stability, but much of the information presented made it clear that there are not sufficient funds available to complete current production programs at optimum rates (low unit costs), let alone complete the new programs that should be started.

As an example, program instability and uncertainty in major DOD programs contribute to an environment that discourages contractors from making long-term, cost saving investments in facilities and equipment. Current restrictions - quite arbitrary - on termination liability discourage the Defense Department and the contractors from entering into longer term agreements which could lead to lower unit costs.

The Task Force also concluded that the planning by OSD and the Services is not based on affordability, cost realism, or constrained

budget levels. One of the principal recommendations of the 1977 DSB Summer Study[1] (DeLauer) was that Full Scale Development should be limited to those programs that can be afforded within the total defense budget. We found little evidence that planning is now proceeding on that basis.

A third conclusion relating to program stability is that reprogramming thresholds are so low, that program managers have no flexibility to adjust funds when cost saving opportunities appear. This is, certainly, not a new conclusion. Every recent study on the acquisition process has recommended increasing the thresholds to at least reflect inflation. This Task Force supports the same view.

(1) Report of the Acquisition Cycle Task Force, Defense Science Board 1977 Summer Study dtd. 15 March 1978

INFLUENCE OF REQUIREMENTS

The second major area of emphasis in the study concerned the influence of requirements on unit costs. There seems little question that there is a deep-seated motivation to continually seek increased performance with cost being regarded, not as an element of the requirement, but simply as a constraint on that motivation. The requirements developer represents the "user" and is normally not in the technology business. He has not traditionally been concerned with the cost of acquiring a needed capability, because there is a significant time gap between the stating of a requirement and the time when the costs and affordability of meeting the requirement are known. This decoupling of the requirements and the producing communities does not easily permit rational trade-offs among performance elements and cost.

The Task Force concluded that the Defense Department creates requirements to meet threat projections that often do not materialize. This drives the costs of systems to higher and higher levels. There is, irrationally, a general reluctance to permit development of a future system unless it can be proven to meet even the most inflated, postulated threat. This subject should be reviewed at the national level as a matter of priority.

THE USES OF COMPETITION

The third area of policy evaluation addressed the uses of competition. It was concluded that production competition can reduce unit costs but that the product must be fully defined and there must be a reasonably high level of production planned. It was further noted that there must be substantially more "front end" investment if competing production lines appear desirable.

Full scale development competition was thoroughly discussed and it was concluded that it is useful only under special circumstances, probably limited to widely different concepts of systems. Full scale development competition clearly increases development costs and unless these costs are a very small percent of the total program cost the payback is doubtful. The Task Force found very little definitive evaluation by the Department of Defense on the real cost value of competition - particularly in the area of full scale development competition.

Among other forms of competition is the competition between improvements to current systems and new starts. This is addressed in more detail later in this report.

It has often been suggested that costs could be reduced if the military would use commercial products. It was found that, while this is an attractive idea, the application is difficult under current procurement regulations and logistic concepts. It appears

that the military wants to "buy commercial" as long as it meets Mil Specs! This has little chance of success as a cost saving effort under these rules, but dropping the Mil Spec requirement (or the equivalent) when justified by cost-benefit trade-off, could have a favorable impact on procurement unit cost.

ACQUISITION MANAGEMENT

The fourth area of emphasis was acquisition management. Although the program manager today is much better trained and carefully selected, the group concluded that his authority and flexibility has been eroded. He has little or no authority to make cost/performance trade-offs since he has little budgetary flexibility. The key element that is missing that would permit such trade-offs is a management reserve fund under the control of the program manager.

An even more pervasive restraint to cost effective acquisition management is that there is little incentive for the program manager to increase productivity or lower unit costs. Neither the Government nor the contractors should be expected to make substantial investments in productivity improvements in the face of constant program uncertainties. Currently, DOD spends little research and development dollars directed toward reducing recurring costs, and there is little or no incentive for industry to invest when returns are low or doubtful and program continuity is uncertain.

The Task Force reviewed the application of value engineering techniques, and concluded that it had substantial potential for unit cost reduction in large volume production. The support in recent years has been sporadic but it has been used successfully on programs where production runs are long.

Several other related subjects were examined; the conclusions reached were:

- Design to Cost - This technique focuses attention of both Government program managers and contractors to lower cost. Current application varies widely and few really complete cases exist. However, the discipline appears to have benefited the programs where it has been applied.

- Impact of Directives, Specifications and Regulations - The number of directives are burdensome to managers and increase administrative cost; particularly in the "front-end" of a program. The impact on recurring unit costs could not be quantified, but the general conclusion was that uncritical application of specifications and standards added to cost.

- Warranties and Contractor Support - Warranties and service life policies can frequently be successfully employed with a saving in total program cost through an increase in system reliability. To make it effective, such policies must be combined with an acceptable form of contractor operated logistics support in early deployment stages. Successful use of warranties and contractor support in commercial programs, both large and small, proves its feasibility.

- Manufacturing Technology (MAN TECH) - The current Service Man Tech contract efforts concentrate on innovative new materials and associated manufacturing processes, and not on developing improvements in the present manufacturing process. The funding levels, though increasing, are low compared to other technology support. Increased funding could be productive.

- Use of Industry Input for Cost Reductions - Industry has knowledge, experience, and inventiveness in cost reduction that is largely unused by DOD. They are not tasked in the early part of the acquisition process to examine the cost implications of new requirements and to suggest substantial changes to the planned program to reduce costs. If this were consistently done, some major cost savings could result.

"CAPABILITY IMPROVED" SYSTEMS

A fifth subject of emphasis was the capability improvement of fielded systems. A number of existing systems have increased in capability over the years as the result of evolutionary growth. Such improvement has generally been as the result of the inability of the Service to get approval for a new development. There are no "automatic" advocates for this approach at the senior levels of the Services or in OSD. DOD procedures call for consideration of improvements of current systems during the acquisition process, but they are not normally supported. This process, creatively followed, could be a gold mine for future performance improvements at minimum cost.

COST ESTIMATION DURING ADVOCACY

One conclusion that is interwoven among the several previous subjects addressed is that realistic cost estimates are seldom available to DOD decision makers until after the system is well into the Engineering Development Phase. The cost estimating capability of the military departments appears to have improved in recent years, but cost estimates are still generally well below the actual probable cost of the systems. It was concluded that a principal cause of this optimism is the strong pressure by program advocates to keep the estimates "affordable" combined with the reviewer's inability to prove an "actual" probable cost. We feel that this general problem is worthy of continued attention to find a rational solution.

RECOMMENDATIONS AND INITIATIVES

The Task Force developed a series of recommendations and four specific initiatives. There is not a "one to one" correlation between the recommendations and the initiatives since there were no obvious singular initiatives that could be defined to help solve the problems addressed by all of the recommendations. Furthermore some initiatives suggest actions that would fulfill more than one of the recommendations. The major recommendations are:

To improve program stability

- In the short term, DOD should request the Congress to eliminate arbitrary restrictions on termination liability.
- As a long term objective, DOD should seek legislation and OMB agreement that would permit multi-year appropriations for production programs[1] that exceed three years and exceed $1 billion.
- DOD components must plan acquisitions on the basis of reasonable, affordable budget levels, utilizing realistic cost estimates, eliminating lower priority programs, selecting the rates of production (and the costs that fit the rates) to stay within affordability limits.

(1) While development programs would also benefit from Multi-Year funding, the primary gains would be achieved in production programs.

- Management reserves under the control of the program manager should be established to take advantage of cost saving opportunities.
- DOD should again request increases in reprogramming authority.

To discipline requirements

- Create a mechanism in the services to scrub requirements so that future affordability is properly assessed and can be achieved.

To selectively increase use of competition

- Selectively increase use of competition for potentially high production programs, and for advanced sub-systems.
- Encourage competition between capability improvements on existing systems and "new start" concepts.
- Create an environment in which commercial products can compete.
- Consider full scale development competition where development cost is a small percent of total program cost.

To improve acquisition management

- Program managers must be given maximum authority and flexibility to

- oo Negotiate charter
- oo Insure key personnel selection and stability
- oo Develop acquisition strategy
- oo Tailor application of governing directives
- oo Utilize cost/performance trade-offs within established limits.

o Establish and use Program Affordability Requirement Evaluation (PARE) Teams, to provide an independent requirements audit for Service SARC's, and assessment of affordability. (See also Initiative II.)

o Increase productivity, as a means of lowering unit cost by

- oo Financially supporting competing contractors to rationally set specific productivity targets prior to production contract award.
- oo Modifying IR&D scoring practice to encourage productivity research tasks.
- oo Using R&D funds to reduce recurring costs.
- oo Expanding value engineering application.
- oo Assuring contractor of reasonable investment recovery for productivity improvements.

o Re-emphasize the principles of "Design to Cost" and discipline its application.

o Tailor the application of the many directives, regulations, specs and standards by

- oo Both permitting and requiring the program manager to "tailor" the numerous management directives as part of his acquisition strategy.

- oo Supporting ongoing efforts by DUSR&E (Acquisition Policy) to reduce and codify management directives.
- oo Assigning responsibility and authority to the Defense Acquisition Executive for all directives that are primarily related to the acquisition management process.

- o Each Service should select one or more system planned for introduction into the inventory and combine warranty and service life policy with contractor furnished service, logistics, configuration control, etc. to verify the extent to which such support can decrease costs and improve and accelerate readiness.
- o The Manufacturing Technology program should be reassessed, and increased effort applied to general methods improvement applicable to many future programs.
- o Utilize the inherent capability of industry to provide inputs for cost estimates and cost reduction by
  - oo Tasking contractor studies to estimate and substantiate costs during Phase 0 and Phase I of the acquisition process.
  - oo Providing significant contractual incentives for implementing cost reduction opportunities.

To ensure proper consideration of capability improvement of Fielded Systems

- Advocacy for "Product Capability Improved" Systems should be established in the Services and OSD at senior levels.
- A "Product Capability Improved" System alternative should be required as a response to each Mission Element Need Statement.

INITIATIVES

Four specific initiatives are proposed:

Initiative I - This initiative has two parts and addresses funding consistency to enhance program stability. First, the services and OMB should be required to support, and the Congress should be requested to approve, multi-year funding authority for new major programs. As noted earlier, these should be programs that meet the criteria of 3 years and $1 billion. Each selected program should be the subject of a carefully monitored experiment to measure the benefits of multi-year funding. Second, OSD should again request change in legislation to adjust reprogramming thresholds. Instead of specific dollar levels, it is strongly urged that thresholds be stated in percentage terms. 10% of line item value in RDT&E and 5% in procurement are believed to be reasonable and helpful.

Initiative II - In order to improve cost credibility and to ensure that requirements are assessed for affordability, it is proposed that "PARE" - Program Affordability Requirements Evaluation - teams be established in each of the Services. These teams would be adversarial in nature and would provide inputs to Service SARC's. Their functions would include assuring that requirements have been scrubbed with cost and quantity trade-offs, that the best cost estimates possible are available, that "affordability" is properly addressed, and that well-thought out, competing alternatives are

analysed. These competing alternatives should include "capability improvement" versions of current systems if applicable. The desired effect of such teams is to focus all acquisition decision elements on reduced unit cost.

Initiative III - Stability of programs would encourage industry to make long term investments for the purpose of lowering unit costs but, in addition, there are frequently important opportunities for saving money in the short term if funds could be made available on short notice. It is suggested that a "Defense Acquisition Cost Reduction Fund" be created which is used only to lower unit cost. The amount must be significant - at least 1% of procurement funds - and it would be invested by the Defense Acquisition Authority in opportunities for large unit cost reductions. Programs would compete for funds from this account on the basis of costs that can be saved.

Initiative IV - The Task Force had reservations about official competition during full scale engineering development for reasons noted earlier. Such competition is an open invitation to "Buy-in" and a complete development team is lost when the source selection is finally made. It is suggested that an experiment be conducted in modified development competition if such competition appears to be desirable. Currently, when a second source is brought in it is after proof of the production package - a necessary requirement. The second source enters with a "cold" engineering and production team - or none at all.

To avoid this, it is suggested that after the competitors have been narrowed to two, a competition be held to select the winner for full scale development. The loser, by prior agreement, would then become a subcontractor to the winner for specific design, test, and analysis functions aimed at reducing the cost of the production item. Thus the second source keeps an essential part of its team together, participates in production definition and is knowledgeable to perform as the production "follower". It is recommended that each Service select one program for implementation of this type of experiment.

MONITORING TEAM

Dick DeLauer noted in the presentation of the DSB 1977 Summer Study on the Acquisition Cycle that the Acquisition System is the most important system in the DOD. It needs continuous attention since the impact of new concepts and disciplines is small unless they are continuously monitored and nurtured. In order to assist in implementation, the Task Force recommends that a team from this study group be established to follow and monitor the response of DOD elements to the recommendations and initiatives of this study effort.

The follow-up team would be responsible for explaining and selling the concepts, and for monitoring the incorporation of, and assessing the eventual value of, the recommendations.

The conclusions of this monitoring team would be reported to the DSB, the Services, the Defense Acquisition Executive, and the Secretary of Defense. It is hoped that such a team would leave footprints for the DSB - develop a form of corporate memory. OSD will need to look again in the future - THE PROBLEM WON'T GO AWAY!

ANNOTATED FINAL BRIEFING

CHART 1 REDUCING THE UNIT COST OF EQUIPMENT

CHAIRMAN - W. HAWKINS

VICE-CHAIRMAN - JOHN RICHARDSON

PANEL 1: JOE SHEA

PANEL 2: NORM AUGUSTINE

PANEL 3: ROLAND PETERSON

EXECUTIVE SECRETARY - PAUL BERENSON

WITH MAJOR ASSISTANCE FROM:

ROBERT GIBSON

JIM DRAKE COL PAUL KAMINSKI

HOWARD WING LTCOL M. GOLDSTEIN

CHART 1

THE ORGANIZATIONAL AFFILIATIONS AND POSITIONS OF THE PERSONS NAMED ARE:

Willis M. Hawkins	-	Senior Vice President-Aircraft Lockheed Corporation
John Richardson	-	President Hughes Aircraft
Joe Shea	-	Senior Vice President Raytheon
Norm Augustine	-	Vice President, Technical Operations Martin-Marietta
Roland Peterson	-	President Guidance & Control Systems Division Litton
Paul Berenson	-	Deputy Assistant to the Secretary of Defense (Atomic Energy)

A working group supported the general activity of the Task Force:

Robert Gibson	-	Director, New Business Planning Lockheed Missiles & Space Co.
Jim Drake	-	Corporate Director of Advance Prgm Plans Hughes Aircraft
Howard Wing	-	Staff Member, Raytheon
Paul Kaminski	-	Col. USAF - Special Assist. to Dr. Perry
Mike Goldstein	-	LCol. USAF - Office of Deputy Chief of Staff, R&D

In addition, two members of the working group participated in developing the background material, but were not present at Newport:

Dick Garretson	-	Headquarters, Naval Materiel Command
Mike Hatcher	-	LCol., USA, Office of Deputy Chief of Staff, RDA

CHART 2

ASSIGNED TASK

- EXAMINE ALTERNATIVES FOR REDUCING UNIT COST
  - USE OF COMPETITION
  - USE OF COMMERCIAL PRODUCTS
  - CONTRACT AND SPECIFICATION FLEXIBILITY
  - INCENTIVES FOR REQUIREMENTS TAILORING
  - INCENTIVES FOR INDUSTRIAL INVESTMENT TO IMPROVE PRODUCTIVITY
  - MODIFICATION OF EXISTING SYSTEMS FOR PERFORMANCE IMPROVEMENT TO COMPETE WITH NEW SYSTEMS
  - INCENTIVES FOR PROGRAM MANAGERS
- IDENTIFY ACTIONS THAT MIGHT WORK

CHART 2

The assigned task was outlined in a memorandum from Dr. Perry, USDR&E to Chairman Defense Science Board dated 7 June 1979. The key to the study activity is the emphasis on actions that might work.

CHART 3

PANEL ONE

THE USES OF COMPETITION AND INCENTIVES

1. HOW BEST TO USE COMPETITION TO REDUCE COSTS?
2. WHAT INCENTIVES CAN BE APPLIED TO REDUCE COSTS?

CHAIRMAN	ORGANIZATION	POSITION
JOSEPH F. SHEA	RAYTHEON	SENIOR VICE PRESIDENT & SPECIAL ASSISTANT
MEMBERS		
CHARLES A. FOWLER	MITRE	VICE PRESIDENT, BEDFORD DIV.
HOWARD GATES	SELF EMPLOYED	CONSULTANT
JOHN B. JACKSON	IBM	PRESIDENT, FEDERAL SYSTEMS DIV.
ALLAN J. ROSENBERG	GENERAL ELECTRIC	GENERAL MANAGER, AEROSPACE INSTRUMENTS & ELECTRICAL SYS.
LEVERING SMITH, VADM USN(RET)	SELF EMPLOYED	CONSULTANT
JOHN E. STEINER	BOEING	VICE PRESIDENT, CORPORATE PRODUCT DEVELOPMENT
LEONARD SULLIVAN	SYSTEM PLANNING	CONSULTANT
EXECUTIVE SECRETARY		
BRADY M. COLE, CAPT SC, USN	OUSDRE	SPECIAL ASSISTANT OUSDRE/AP

CHART 3

The three consultants have previously had major responsibilities in Defense management.

Howard Gates - Army Secretariat

Levering Smith - VADM USN (Ret)
Director, Strategic Systems
Project Office

Leonard Sullivan - Asst. Secretary of Defense
Program Analysis & Evaluation

CHART 4

PANEL TWO

TIMING OF NEW STARTS

1. MATCHING REQUIREMENTS TO AFFORDABILITY
2. EVALUATING EXTENSION OF EXISTING SYSTEMS AND NEW STARTS

CHAIRMAN	ORGANIZATION	POSITION
NORMAN R. AUGUSTINE	MARTIN MARIETTA	VICE PRESIDENT, TECHNICAL OPERATIONS
MEMBERS		
GEORGE HUEBNER	ENVIRONMENTAL RESEARCH INSTITUTE	CHAIRMAN OF THE BOARD
WILLIAM J. EVANS, GEN USA(RET)	UNITED TECHNOLOGIES CORP	VICE PRESIDENT
ALEXANDER H. FLAX	IDA	PRESIDENT
GEORGE H. HEILMEIER	TI, INC	VICE PRESIDENT FOR CORPORATE RD&E
DAVID R. HEEBNER	SAI	SENIOR VICE PRESIDENT
RICHARD TRAINOR	TRAINOR ASSOCIATES, INC	PRESIDENT
ROBERT J. LUNN, MGEN USA	DARDA	ASSISTANT DEPUTY CHIEF OF STAFF
J. K. WOODMANSEE, BGEN USA	TRADOC	DIRECTOR COMBAT DEVELOPMENT
EXECUTIVE SECRETARY		
CHARLES W. BERNARD	OUSDRE	DIRECTOR LAND WARFARE

CHART 4

Six members of this panel were previously in high government positions.

CHART 5

PANEL THREE

COST IMPACT OF ACQUISITION PROCEDURES

1. PROGRAM STABILITY
2. TAILORING OF ACQUISITION PROGRAMS (IN ALL RESPECTS)
3. INDUSTRY'S ROLE IN COST REDUCTION

	ORGANIZATION	POSITION
CHAIRMAN		
ROLAND PETERSON	LITTON	PRESIDENT, GUIDANCE AND CONTROL SYSTEMS DIVISION
VICE CHAIRMAN		
DALE W. CHURCH	OUSDRE	DEPUTY UNDERSECRETARY OF DEFENSE FOR R&E (ACQ. POLICY)
MEMBERS		
RICHARD ADAMS	GD	VICE PRESIDENT & GENERAL MGR. FORT WORTH DIVISION
EDWIN BARRINEAU, RADM USN	NAVAIR	ASS'T CDR FOR TEST AND EVAL.
TOMMY BELL, BGEN USAF	HQ. USAF	DIRECTOR OF DEVELOPMENT AND PROCUREMENT
JOHN D. BLANCHARD	DARCOM	ASS'T DEPUTY COMMANDING GENERAL MATERIEL DEVELOPMENT
CLARENCE G. CARLSON	HUGHES A/C CO.	GROUP EXECUTIVE, GROUND SYSTEMS GROUP
GEORGE S. SEBESTYEN	DEFENSE SYSTEMS, INC.	PRESIDENT
JAMES W. STANSBERRY, MGEN, USAF	AFSC	DCS, CONTRACTING AND MFG., HQ AFSC
EXECUTIVE SECRETARY		
FRED KELLEY	DEFENSE SYSTEMS MGT. COLLEGE	ASSOC. DEAN, SYSTEMS ACQU. EDUCATION

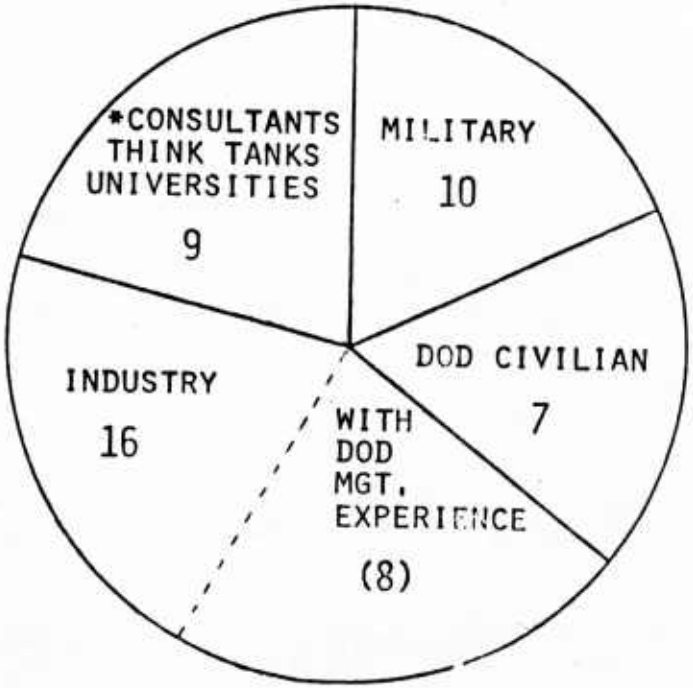
CHART 5

In addition to the panel members listed, Jerry Stolarow, Director, Procurement & Systems Acquisition Division, GAO, provided important inputs.

CHART 6

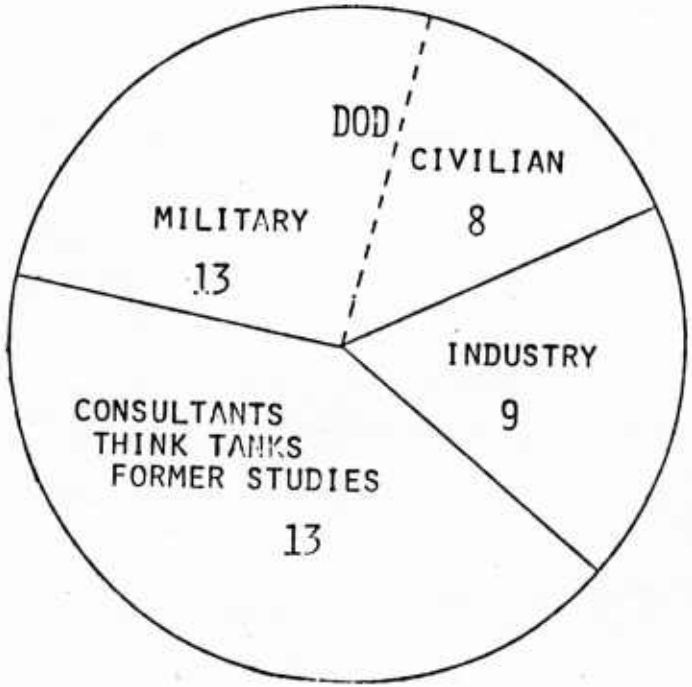
STUDY PERSONNEL COMPOSITION

STUDY MEMBERS



*ALL WITH FORMER DOD MANAGEMENT EXPERIENCE

BRIEFERS



MAJOR SUBJECTS COVERED:

- PREVIOUS STUDIES: DELAUER, NMARC, ETC.
- PRODUCT IMPROVEMENT PROGRAMS
- DESIGN TO COST
- COMMERCIAL PRACTICES
- ACQUISITION MANAGEMENT - SENIOR MILITARY-MATERIEL COMMANDS
- COMPETITION

CHART 6

The Task Force was fortunate to have discussions with senior officers of each Service Materiel Command —

General Jack Guthrie	-	Commander, DARCOM
Admiral Al Whittle	-	Commander Naval Materiel Command
MGen. Jim Stansberry	-	Deputy C/S Air Force Systems Command

These informal discussions were invaluable in identifying the inhibitors to reducing unit costs.

CHART 7

ENVIRONMENT

- ONLY MODEST BUDGET INCREASE CAN BE EXPECTED
- RUSSIAN ARMS BUILD UP
- COMPETING DOLLAR DEMANDS AMONG MAJOR STRATEGIC PROGRAMS, THEATER-NUC MODERNIZATION, AND GENERAL PURPOSE FORCES
- URGENT NEED TO REACH EQUIVALENCE IN TACTICAL MILITARY CAPABILITY

- COST REDUCTIONS, WITHIN LIMITS, CAN BE ACCOMPLISHED, BUT WILL NOT FIX THE PROBLEM OF EQUIVALENCE
  - REDUCE UNIT COST OF EQUIPMENT
  - INCREASE CAPABILITY OF EXISTING PLATFORMS
  - REDUCE NUMBER OF NEW STARTS AND BUY MORE EXISTING WEAPONS

CHART 8

AFFORDABILITY

TO MAINTAIN CURRENT INVENTORY

WITH CURRENT PROCUREMENT BUDGET

REQUIRES ROUGHLY A 40 PERCENT

REDUCTION IN AVERAGE UNIT COST.

CHARTS 7 & 8

A fundamental premise of this study is that the DOD procurement account will have only a modest increase —— in real terms —— in the next decade. The current practice of buying fewer numbers of high cost items will continue unless some very difficult decisions are made by Defense management.

The major conclusion reached by the Task Group is that there are steps that can lead to cost reductions, but such steps will not solve the problem of equivalence. In fact, as shown in Chart 8, unit cost reduction has no chance of even solving the problem of maintaining current inventory. Cost reduction will help, however, and the Task Force conclusions and recommendations shown in succeeding charts should assist the reduction process.

CHART 9

AREAS OF CONCENTRATION

- STABILITY OF PROGRAMS
- DISCIPLINING REQUIREMENTS
- USE OF COMPETITION
- ACQUISITION MANAGEMENT
- PRODUCT CAPABILITIES IMPROVEMENT

CHART 9

The Task Force was organized in the three panels shown earlier, but it soon became clear that there was much interaction in the panel assignments. The effort was restructured to concentrate in the five areas shown. Recommendations were developed in these areas; Initiatives are proposed to induce action in support of the recommendations.

CHART 10

PROGRAM STABILITY HAS POWERFUL IMPACT ON REDUCING UNIT COSTS

RECOMMENDATIONS

1. LONG TERM FUNDING COMMITMENTS ARE ESSENTIAL TO PROGRAM STABILITY

   - IN THE SHORT TERM, DoD SHOULD REQUEST THE CONGRESS TO ELIMINATE ARBITRARY RESTRICTIONS ON TERMINATION LIABILITY

   - AS A LONG TERM OBJECTIVE, DoD SHOULD SEEK LEGISLATION AND OMB AGREEMENT THAT WOULD REQUIRE MULTI-YEAR APPROPRIATIONS FOR PRODUCTION PROGRAMS THAT

     A) EXCEED THREE YEARS, AND

     B) EXCEED $1 BILLION

     AND OTHER PROGRAMS THAT WARRANT MULTI-YEAR FUNDING BASED ON PRIORITY AND LEVEL OF RISK

CHART 11

PROGRAM STABILITY HAS POWERFUL IMPACT ON REDUCING UNIT COSTS

RECOMMENDATIONS (CONT.)

2. DoD COMPONENTS MUST ACHIEVE PROGRAM STABILITY BY:

   - PLANNING ACQUISITION ON THE BASIS OF AFFORDABILITY, REASONABLE BUDGET LEVELS, AND COST REALISM
   - EARLY ELIMINATION OF LOWER PRIORITY PROGRAMS
   - SETTING AN ECONOMICAL RATE OF PRODUCTION WITHIN AFFORDABILITY LIMITS AS A PART OF ACQUISITION STRATEGY
   - PROVIDING ADEQUATE PROGRAM FUNDS TO TAKE ADVANTAGE OF COST SAVING OPPORTUNITIES

3. INCREASING REPROGRAMMING AUTHORITY

CHARTS 10 & 11

The current $5 million limit on termination liability has a strong inhibiting effect on entering into multi-year contracts. The Task Force believes that if this restriction were modified, more long term agreements would be entered into, with resultant unit cost savings.

Multi-year appropriations would contribute immeasurably to program stability, but DOD must recognize the internal responsibilities that go with multi-year funding. The planning process in OSD and the Services must be improved. The Services must create agreed on plans and OSD must assist in helping the Services stick to them.

A word of explanation about reprogramming as used on Chart 11. In this case, the Task Force recommends judicious reprogramming to avoid program instabilities. It was indicated to the Task Force that reprogramming is now so difficult and time-consuming that Program Managers are reluctant to initiate such requests.

The last item on Chart 11 is an indirect way to say that a system needs to be established which provides reserves for the unforeseen events. The current lack of funding flexibility has increased unit costs. See Appendix A for further discussion.

CHART 12

DISCIPLINING REQUIREMENTS

CREATE A MECHANISM IN THE SERVICES TO SCRUB REQUIREMENTS SO THAT FUTURE AFFORDABILITY IS PROPERLY ASSESSED AND INCORPORATED. THIS WILL DEMAND A MAJOR CULTURAL CHANGE IN REQUIREMENTS DEVELOPMENT WHERE "WILL COST" AND AFFORDABILITY RESTRAINTS ARE RECOGNIZED AT THE BEGINNING:

- DO NOT DESIGN FOR THREAT GROWTH AND DEPEND ON EVOLUTION OF WEAPON SYSTEMS
- ASSESS COST IMPLICATIONS OF NEW REQUIREMENTS
  - USE CONCEPT AND COST INPUTS FROM INDUSTRY
  - USE OTHER INDEPENDENT SOURCES
- REQUIREMENTS DEVELOPMENT MUST ASSESS IMPROVED PRESENT SYSTEMS AND SUBSYSTEMS VS. NEW TECHNOLOGY SYSTEMS
- DO NOT DEMAND HIGH RISK ADVANCED TECHNOLOGY SYSTEMS OR SUBSYSTEMS UNLESS ABSOLUTELY ESSENTIAL

CHART 12

In disciplining requirements careful consideration must be given to the level of advanced technology that is demanded. There must be resistance to jumping on the invention bandwagon.

CHART 13

COMPETITION - RATIONALE

- COMPETITION IS A POWERFUL MOTIVATOR FOR COST CONTROL
- STUDIES SHOW PRODUCTION COMPETITION CAN REDUCE UNIT COST
  - ELECTRONICS X (1973)
  - IDA STUDY (1979)
  - RAYTHEON STUDY (1979)
  - HUGHES STUDY (TOW)
- SOME PRODUCTION COMPETITION TECHNIQUES HAVE BEEN DEMONSTRATED
  - WINNER TAKE ALL
  - LEADER/FOLLOWER
  - SPLIT BUY
- FULL SCALE DEVELOPMENT COMPETITION
  - SUBSTANTIALLY INCREASES DEVELOPMENT COST WITH INDETERMINATE PAYBACK
  - MAY BE JUSTIFIED IF DEVELOPMENT COST IS SMALL PERCENT OF TOTAL PRODUCTION COST
  - SOLE SOURCE DEVELOPMENTS NEED NOT CLOSE OFF PRODUCTION COMPETITION

CHART 14

COMPETITION LIMITATIONS

RECOGNIZE THE LIMITS TO COMPETITION

- PRODUCT HAS BEEN PROVEN, FULLY DEFINED, AND HAS REASONABLE PRODUCTION QUANTITY
- COMPETITION IS NO SUBSTITUTE FOR EARLY FUNDING FOR THE PROGRAM
- FRONT END INVESTMENT ESSENTIAL FOR COMPETITION AND TAKES TIME TO RECOUP
- MORE TIME MAY BE NEEDED TO QUALIFY, EVALUATE, AND BRING COMPETITORS UP TO SPEED
- COMPETITORS MUST BE QUALIFIED OR TRAINED

CHART 15

USE OF COMPETITON - RECOMMENDATIONS

- SELECTIVELY INCREASE USE OF COMPETITION
  - HIGH PRODUCTION PROGRAMS
  - TEST BEDS FOR LOWER UNIT COSTS CONCEPTS
  - PRODUCTION COMPETITION OF ADVANCED SUBSYSTEMS
- ENCOURAGE COMPETITION BETWEEN CAPABILITY IMPROVEMENTS ON EXISTING SYSTEMS AND NEW STARTS
- CREATE AN ENVIRONMENT IN WHICH COMMERCIAL OR OFFSHORE PRODUCTS CAN ENTER THE SYSTEM

CHARTS 13, 14 & 15

Competition - Rationale

Material presented to the Task Force analyzed past experience which might support the intuitive feelings about the value of competition in reducing costs. The studies presented all addressed the value of competition, but the Task Force was not favorably impressed with the study results. They often analyzed special cases, assumptions were rationally questioned and the extrapolations appeared to be weakly supported. In spite of the weaknesses in the studies, the consensus of the Task Force remained positive.

The Task Force was asked to carefully examine the question of expanding competition to full scale development. It concluded that total development cost would be increased and the payback is indeterminate. While there may be other reasons for conducting full scale engineering development competitions, they are not justified from a unit cost reduction standpoint.

Competition - Limitations

There are limits to competition but there appears to be little quantification of these limits. Establishing competition takes time, and front end investment by DOD. In several case studies examined, it took 4-5 years to bring a production competitor on line.

These limitations are real but the Task Force does not want to leave the impression that competition should be restricted or restrained by policy. The policy should be followed that competition as a cost saving tool should be analyzed in each case and should be used carefully to get the most benefit.

Competition - Recommendations

Test beds for lower unit cost concepts could be utilized. Currently, test beds are almost universally used for "wringing out" high risk (and usually high cost) approaches. Test beds could also be useful in exploring concepts that lead to lower unit costs. Such test beds would provide iteration among developers and users to determine or demonstrate that lower cost approaches fulfilled tactical needs.

CHART 16

ACQUISITION MANAGEMENT TAILORING

PROGRAM MANAGER MUST BE GIVEN MAXIMUM AUTHORITY AND FLEXIBILITY TO:

- NEGOTIATE CHARTER (STRONG VOICE)
- INSURE KEY PERSONNEL SELECTION AND STABILITY (A MUST)
- DEVELOP ACQUISITION STRATEGY (FIGHT FOR)
- NEGOTIATE APPLICATION OF GOVERNING DIRECTIVES (TAILOR)
- PERMIT COST/PERFORMANCE TRADE OFFS WITHIN ESTABLISHED LIMITS (MINIMIZE CONSTRAINTS)

CHART 16

The authority of the program manager has eroded over the years. This chart indicates some steps that can be taken to strengthen this essential management function. Of prime importance is the support by the Services for high priority selection of key personnel and the dedication to maintain stability in the assignment. Obviously, this applies to both industry and Government.

The program manager must develop an acquisition strategy that fits his product, and he should be supported in that strategy.

The program manager generally has been responsible for tailoring working specifications and standards, but in the past he has had little opportunity to "tailor" the important directives from above. For example, a program manager has little latitude in applying accepted cost and schedule control systems, even when they might be inappropriate.

Most importantly, the program manager should be given authority to make cost/performance trade-offs within previously established limits without reference to higher authority. This authority is essential if the program manager is to maintain schedule and utilize cost-saving ideas.

CHART 17

ESTABLISH AND USE SERVICE "PARE"* TEAMS

(TO PROVIDE AN INDEPENDENT REQUIREMENT AUDIT FOR SERVICE SARCS)

- REVIEW REQUIREMENT
  - OVERSPECIFIED?
  - ALTERNATIVES?
- ASSESS AFFORDABILITY (DEVELOPMENT AND PRODUCTION)
  - AVAILABLE FUNDS?
  - COST INTEGRITY?

---

* PROGRAM AFFORDABILITY REQUIREMENT EVALUATION (PARE) TEAMS

CHART 17

As the acquisition process proceeds, cost estimates to meet earlier stated requirements become more nearly valid. On the other hand, the optimism of the advocates becomes even greater. In order to provide an independent input to the Service SARC's to aid in their decision-making, it is suggested that special review teams be formed. An important part of their function would be to assess the affordability impact of the proposed system: Is the program a "bow wave" maker or can it be accommodated within foreseeable budget level? —— Is there cost integrity in the estimates or are they optimistic and unrealistic dreams? —— Have lower cost alternatives, like updates of existing systems, been adequately examined?

The desired effect of such teams would be to focus the total acquisition system on reducing unit cost.

CHART 18

ACQUISITION MANAGEMENT
INCREASE PRODUCTIVITY FOR LOWER UNIT COST

- FINANCIALLY SUPPORT COMPETING CONTRACTORS TO PREPARE FOR SPECIFIC PRODUCTIVITY TARGETS PRIOR TO PRODUCTION CONTRACT AWARD. THIS COULD INCLUDE TOOLS, SOFTWARE, TRAINING
- MODIFY IR&D SCORING PRACTICE TO ENCOURAGE PRODUCTIVITY TASKS
- SPEND R&D MONEY TO REDUCE RECURRING COSTS
- EXPAND VALUE ENGINEERING APPLICATION
- ASSURE CONTRACTOR OF REASONABLE INVESTMENT RECOVERY FOR PRODUCTIVITY IMPROVEMENT

CHART 18

Most companies use their IR&D investment in advanced technology to lead to new products, and invest only a small amount in productivity improvement tasks. Part of the reason is that the current IR&D scoring practices do not encourage productivity tasks. If additional DOD R&D funds were applied toward widely applicable cost reduction efforts, industry would be encouraged to make similar investments on their own initiative.

CHART 19

CAPABILITY IMPROVEMENT OF FIELDED SYSTEMS

- A "PRODUCT CAPABILITY IMPROVED" ALTERNATIVE SHOULD BE INCLUDED IN THE DSARC AND PPBS
  - ADVOCACY FOR "PRODUCT CAPABILITY IMPROVED" SYSTEMS SHOULD BE ESTABLISHED IN THE SERVICES AND OSD AT SENIOR LEVELS
  - EMPHASIZE AND MONITOR ROUTINE EVALUATION OF "PRODUCT CAPABILITY IMPROVED" SYSTEMS AS ALTERNATIVES AND AS HIGH/LOW MIX ELEMENTS
  - ASSURE CONSIDERATION OF A "PRODUCT CAPABILITY IMPROVED" SYSTEM ALTERNATIVE AS A RESPONSE TO EACH MENS (INCLUDE ADEQUATE R&D FUNDING FOR THIS PURPOSE)

THIS, IF DONE PROPERLY, LIKE THE REQUIREMENTS AUDIT, WILL DISTURB THE CULTURE OF THE DEPARTMENT OF DEFENSE. THE CHIEFS AND SECRETARIES MUST SUPPORT THE CONCEPTS TO PRODUCE LOWER COST SYSTEMS AND THUS CHANGE THE CULTURE

CHART 19

Everyone contributes to the culture of reaching too far in new systems and there is little advocacy to "grow" current systems into expanded capabilities. At the present, product capability improvements are generally done as a fall-back when it is clear that new systems will not be initiated. The current directives are adequate, since they require consideration of improving current systems, during the early part of the acquisition process. The implementation, however, hasn't been vigorous and support from the Services and OSD management appears to be spotty at best.

CHART 20

INITIATIVE I

MULTI-YEAR FUNDING

- MULTI-YEAR FUNDING OF PROGRAMS HAS BEEN BENEFICIAL IN A NUMBER OF CASES
- BASED ON THESE CASES, THE SERVICES AND OMB SHOULD BE REQUIRED TO SUPPORT AND THE CONGRESS SHOULD BE REQUESTED TO APPROVE MULTI-YEAR FUNDING AUTHORITY ON ADDITIONAL, MAJOR PROGRAMS
- THE ADDITIONAL PROGRAMS WILL BE THE ESSENTIAL ELEMENTS OF A CAREFULLY MONITORED EXPERIMENT TO MEASURE THE HYPOTHESIZED BENEFITS OF MULTI-YEAR FUNDING
- INDICATED BENEFITS
  - PROGRAM STABILITY
  - LONG LEAD ECONOMY
  - MORE EFFICIENT TOOLING INVESTMENT
  - STABLE BASE FOR CONTINUING UPGRADE BY MODIFICATION
  - MAXIMUM PAYOFF POTENTIAL FROM VALUE ENGINEERING

CHART 21

INITIATIVE I (CONT.)

- DoD SHOULD ALSO REQUEST CHANGE IN LEGISLATION TO INCREASE THE REPROGRAMMING THRESHOLD TO 10% OF THE LINE ITEM VALUE IN R&D AND 5% IN PROCUREMENT

REASON:

PRESENT LIMITATIONS DO NOT PROVIDE PROGRAM MANAGER ADEQUATE LATITUDE TO EFFICIENTLY MANAGE PROGRAM IN FACE OF CHANGING CONDITIONS

The first initiative has two recommended actions. First, action should be started to develop the use of multi-year funding for production programs. With the criteria of 3 years and over $1 billion there would be a real focus on reducing unit costs. Further, such a commitment is essential if production competition is to be effective in reducing unit costs.

The Task Force suggests that programs funded in this manner be carefully monitored to measure whether the benefits expected are achieved.

Previous studies have supported increasing the reprogramming threshold. The Task Force supports this recommendation but proposes a somewhat different approach. The reprogramming requirements are different for different sized programs. It is suggested that reprogramming be based on the line item value and be a percentage of that value.

With such authority, the program manager could take advantage of cost-saving opportunities such as long lead ordering, tool changes, or initiating new competitive sources.

CHART 22

INITIATIVE II

ESTABLISH "PARE"* TEAMS

- SERVICES TO IMPLEMENT "PARE" AUDIT TEAMS
- "PARE" TEAMS TO ASSURE THAT:
  - REQUIREMENTS HAVE BEEN SCRUBBED (COST/QUANTITY TRADEOFFS)
  - ADEQUATE FUNDING IS AVAILABLE
  - ACCURATE COST ESTIMATES ARE AVAILABLE
  - WELL THOUGHT-OUT ALTERNATIVES ARE AVAILABLE
- REPORT IN STAFF CAPACITY TO SERVICE SARC

●● DESIRED EFFECT IS TO FOCUS ON REDUCED UNIT COST

---

* PROGRAM AFFORDABILITY REQUIREMENTS EVALUATION

This initiative directly supports the previous recommendation. Such a team would assure that the best possible estimates of "will cost" are available —— and known to decision makers. They would also make certain that among the alternatives considered is that of capability improvement of existing systems.

As noted earlier, the desired effect of such a team assignment is to inject consideration of reduced unit cost early and continuously in the acquisition cycle.

CHART 23

INITIATIVE III

DFFENSE ACQUISITION COST REDUCTION FUND

- CREATE AN ACCOUNT AVAILABLE TO DEFENSE ACQUISITION EXECUTIVE AND DIRECTED TO LOWER UNIT COST

- AMOUNT MUST BE SIGNIFICANT (E.G., 1% OF PROCUREMENT FUNDS) FOR INVESTMENT IN OPPORTUNITIES FOR LARGE UNIT COST REDUCTIONS

- PROGRAMS WOULD COMPETE FOR FUNDS ON BASIS OF COSTS THAT CAN BE SAVED

CHART 23

The proposed cost reduction fund would be applied to short term, short lead time opportunities. Program stability helps industry invest for the longer term, but there will be times when unit costs can be reduced by judicious additional investment. This fund would permit such activity.

CHART 24

INITIATIVE IV

AN EXPERIMENT IN MODIFIED DEVELOPMENT IF PRODUCTION COMPETITION IS DESIRED

PROBLEM:

- COMPETING FULL SCALE ENGINEERING DEVELOPMENT IS OFTEN AN INVITATION TO BUY-IN, AND A COMPLETE DEVELOPMENT TEAM IS LOST WHEN THE SOURCE SELECTION IS MADE
- IF PRODUCTION COMPETITION OR A SECOND SOURCE IS DESIRED, ONE TEAM OFTEN WAITS UNTIL PROOF OF THE PRODUCTION PACKAGE, AND PROBABLY PRODUCTION ARTICLE DEPLOYMENT, BEFORE BEING INTRODUCED INTO THE PROGRAM AS A SECOND SOURCE. THE SECOND SOURCE THUS ENTERS WITH A COLD ENGINEERING AND PRODUCTION TEAM OR NONE AT ALL
- TO AVOID THESE PROBLEMS, IT IS SUGGESTED THAT AFTER THE COMPETITORS HAVE BEEN NARROWED TO TWO, A COMPETITION BE HELD TO SELECT THE WINNER AND, BY PREVIOUS AGREEMENT, THE LOSER BECOMES A FULL SCALE DEVELOPMENT SUB-CONTRACTOR TO THE WINNER FOR SPECIFIC DESIGN, TEST, AND ANALYSIS FUNCTIONS AIMED AT REDUCING THE COST OF THE PRODUCTION ITEM. THUS, THE SECOND SOURCE KEEPS AN ESSENTIAL PART OF ITS TEAM TOGETHER -- PARTICIPATES IN PRODUCTION DEFINITION AND IS KNOWLEDGEABLE TO PERFORM AS THE PRODUCTION "FOLLOWER"

CHART 24

INITIATIVE IV

It was suggested by the Task Force that this Initiative be approached on an experimental basis and that each Service should select a forthcoming program with good production potential for the experiment. This form of production competition could be initiated and the results carefully monitored to prove the concept and to assess its value in saving unit cost.

CHART 25

INITIATIVE V

FOLLOW-UP TO ASSESS PERFORMANCE ON DSB RECOMMENDATIONS

- RECOMMENDED TEAM: CHAIRMAN, VICE CHAIRMAN, AND PANEL LEADERS
- TEAM WILL BE RESPONSIBLE FOR
  - MARKETING THE RECOMMENDATIONS AND INITIATIVES--TO EXPLAIN AND SELL THEM
  - FOLLOW-UP TO WATCH INCORPORATION AND ASSESS VALUE OF SUGGESTIONS AND OF THE IMPLEMENTATION
  - REPORT CONCLUSIONS TO DSB, SERVICES, DAE, AND SECRETARY OF DEFENSE

CHART 25

The Task Force observed that many past studies with potentially high payoff recommendations have made no impact. It is strongly suggested that a follow-up team be established to explain and sell the concepts embodied in this study and to assess the enthusiasm and effectiveness of the implementation efforts.

The team's efforts should be concentrated in the first six months and finish within 2 years. This would provide footprints for the DSB if OSD wants to look again in the future since THE PROBLEM WON'T GO AWAY.

OTHER CONCLUSIONS AND RECOMMENDATIONS

The final presentation was time constrained and several important subjects which were extensively addressed were not included. The additional conclusions and recommendations are:

Design to Cost - The current application of this discipline varies widely and few complete case histories exist. Those programs briefed to the Task Force appeared to have benefitted substantially by use of this technique. However, the initial concept of Design to Cost seems to have been seriously diluted in the resultant detailed procedures. Artificial and arbitrarry "goals" have been established which really defeat the original purpose. It is recommended that that "Design to Cost" principles be re-emphasized and its application be disciplined.

Impact of Directives, Specifications and Regulations - The number of these documents and policies are burdensome to managers and increase administrative costs. It is recommended that the application of the many directives, regulations, specifications, and standards be tailored as an essential required element of the acquisition strategy.

Further, it is recommended that:

- The ongoing efforts by DUSDR&E (Acquisition Policy) to reduce and codify management directives be supported.

- Responsibility and authority for all OSD Directives that are primarily related to the acquisition management process be assigned to the Defense Acquisition Executive.

Warranties and Contractor Support - Warranties and service life policies can frequently be successfully employed with a saving in total program cost through an increase in system reliability and availability. To make it effective, such policies must be combined with an acceptable form of contractor operated logistics support in early deployment stages. Successful use of warranties and contractor support in commercial programs, both large and small, proves its feasibility. The Task Force recommends that each Service should select one or more systems planned for introduction into the inventory and combine warranty and service life policy with contractor furnished service, logistics, configuration control, etc. to verify the extent to which such support can decrease costs and improve and accelerate readiness.

Manufacturing Technology - The current Man Tech effort concentrates on innovative new materials and associated manufacturing processes, and not on developing improvements in present manufacturing processes. The funding levels, though increasing, are low compared to other technology support. Increased funding could be productive.

- o It is recommended that the Man Tech program be reassessed and increased efforts applied to manufacturing methods improvement which would be applicable to many future programs.

Use of Industry Input for Cost Reductions - Industry has knowledge, experience, and inventiveness in cost reduction that is largely unused by DOD. They are not tasked sufficiently early in the acquisition process to examine the cost implications of new requirements. If this were consistently done, the cost impact of requirements would be better defined and some major cost savings could result.

It is recommended that the inherent capability of industry be utilized by:

- oo Tasking contractor studies directed toward cost reduction during Phase 0 and Phase I of the acquisition process.
- oo Providing significant contractual incentives for implementing cost reduction opportunities.

The recommendations and conclusions contained in this section of the report are discussed in more detail in the Appendices.

APPENDICES

Section I. MEMBERS OF THE TASK FORCE

Mr. Willis M. Hawkins, Chairman	Lockheed Corporation
*Mr. John H. Richardson, Vice Chairman	Hughes Aircraft Company
Dr. Paul J. Berenson, Executive Secretary	OATSD(AE)
Mr. Richard E. Adams	General Dynamics - Fort Worth
Mr. Norman R. Augustine	Martin Marietta Aerospace
RAdm. Edwin Barrineau, USN	Naval Air Systems Command
BGen. Tommy Bell, USAF	ODCS/RDA
Mr. Charles W. Bernard	OUSDRE(Land Warfare)
Mr. John D. Blanchard	Headquarters, DARCOM
Mr. Clarence G. Carlson	Hughes Aircraft Company, Ground Systems Group
Mr. Dale W. Church	DUSDRE(Acquisition Policy)
Capt. Brady M. Cole, USN	OUSDRE(Acquisition Policy)
Mr. James F. Drake	Hughes Aircraft Company
Gen. William J. Evans, USAF (Ret.)	United Technologies Corporation
*Dr. Alexander H. Flax	Institute for Defense Analyses
*Mr. Charles A. Fowler	The MITRE Corporation, Bedford Division
Mr. Richard C. Garretson	Headquarters, Naval Material Command
Mr. Howard Gates	Consultant
Mr. Robert G. Gibson	Lockheed Missile & Space Co.
Lt. Col. Michael R. Goldstein, USAF	ODCS/RDA
Lt. Col. Michael Hatcher, USA	DAMA-RAA

*Member of the Defense Science Board

MEMBERS OF THE TASK FORCE (contd.)

Mr. David R. Heebner	Science Applications, Inc.
*Dr. George H. Heilmeier	Texas Instruments, Inc.
Mr. George J. Heubner, Jr.	Environmental Research Institute
Mr. John B. Jackson	IBM - Federal Systems Division
Col. Paul G. Kaminski, USAF	OUSDRE
Mr. Fred J. Kelley	Defense Systems Management College
Maj. Gen. Robert J. Lunn, USA	ODCS,RD&A
Mr. Roland O. Peterson	Litton, Guidance & Control Division
Mr. Allen J. Rosenberg	GE Company, Aerospace Group
*Dr. George S. Sebestyen	Defense Systems, Inc.
Dr. Joseph F. Shea	Raytheon Company
VAdm. Levering Smith, USN (Ret.)	Consultant
MGen. James W. Stansberry, USAF	DCS, AFSC
Mr. John E. Steiner	The Boeing Company
Mr. Leonard Sullivan	System Planning Corporation
Mr. Richard J. Trainor	Trainor Associates, Inc.
Mr. Howard E. Wing	Raytheon Company
BGen. J. R. Woodmansee, USA	Headquarters, TRADOC

*Member of the Defense Science Board

Section II. PAPERS DEVELOPED DURING STUDY
(Appendices A through J)

Appendix A

PROGRAM STABILITY

Current policies and procurement practices are characterized by: 1) low production rates dictated by the need to spread available funds; and 2) annual (or more frequent) changes in total quantities or annual procurement quantities. There is often no clear government commitment to a long-term program.

These practices have been major contributing factors to the high production costs of major weapons systems which, in turn, have resulted in the procurements of relatively small quantities of weapons. The long-term result is a lessening in the combat force effectiveness.

The crucial requirement is to have sufficient funds to buy in quantities and at affordable rates of production which maximize learning, economies of scale, and the maintenance of an efficient, technically modern production base. Much of the material presented to the Task Force made it clear that there were not sufficient funds available to complete all of the programs being started, let alone with funding at more efficient rates. The so-called "bow wave" (the excess of program funding requirements over available funds) is now in the range of $15-20 billion a year (see Figure I) and there is little prospect of relief.

FIGURE I

ANNUAL PROCUREMENT REQUIREMENTS

(CONSTANT FY 80 DOLLARS, BILLIONS)

	FY 80	FY 81	FY 82
AIR FORCE			
Aircraft (nonbombers)	$ 4.8B	$ 4.2B	$ 4.2B
Strategic Systems	6.8	1.5	2.2
Space	1.6	1.6	1.6
Other Items	6.5	4.4	4.9
TOTAL	19.7	11.7	12.9
NAVY			
Aircraft	3.3	2.7	2.2
Ships (non-SSBN)	6.7	4.0	4.6
Strategic Systems	2.9	2.0	2.6
Other Items	7.5	5.9	5.7
TOTAL	20.4	14.6	15.1
ARMY			
Aircraft	1.0	0.4	0.4
Tanks, IFV	1.2	1.1	1.4
SAMs, Missiles	1.2	0.7	1.0
Ammo	2.2	1.3	1.3
Other Items	4.0	3.0	3.0
TOTAL	9.6	6.5	7.1
DEFENSE AGENCIES	0.3	0.3	0.3
DoD TOTAL PROCUREMENT	$50.0B	$33.1B	$35.4B

To illustrate the effect of insufficient funding, the Department of the Navy presented an example (see Figure 2) of how the unit costs for an aircraft program increased because of program stretchout, as follows:

	UNITS	TOTAL COST (M)	UNIT COST (M)	INCREASE
Original Program (2 years)	179	$2,499	$13.9	
Approved Program (4 years)*	179	$3,021	$16.9	22%

Another element of program instability is the inherent uncertainty in major DoD programs. The annual funding cycle, the stops, starts, delays, and even the uncertainty of program continuation, all contribute to an environment that inhibits contractor and government investments to improve productivity. Further, contractors cannot make cost-saving, long-term commitments with respect to supplies, labor, facilities, etc.

The Task Force believes that program stability can lower costs by 1) enabling production to proceed at optimum affordable rates, 2) permitting contractors to make long-term plans and commitments without undue financial risk, and 3) encouraging the contractors and the government to invest in more productive plant and equipment. In order to achieve improved program stability, it is essential that:

1. DoD components plan procurement programs on the basis of affordability and realistic budget expectations;

*It was the opinion of many Task Force members that the extended production (low rate) could have been achieved at lower cost had this been the original plan consistently maintained.

FIGURE 2

VARIATION IN COST OF 179 OF AIRCRAFT X

WITH ALTERNATE BUY RATES

	AIR FRAME	REST OF PROGRAM	TOTAL PROGRAM	$ OM
BEST SCHEDULE AT COST (93-86)	$1042M	$1432M	$2474M	$
ORIGINAL PROGRAM AT COST (88-91)	1061	1438	2499	25
OSD PROGRAM AT COST (48-48-48-35)	1338	1683	3021	547

2. Major programs be adequately funded on a multi-year basis; and
3. DoD components have a somewhat greater degree of funding flexibility.

These three areas are discussed more fully below.

Affordability

Unfortunately, the existence of bow wave is not just a transient problem. Rather, a combination of management policies and practices has created a continuing and growing bow wave. These include unwarranted optimism with respect to fund availability (i.e., the Five Year Defense Program bears no relation to reasonably expectable budgets), a failure to utilize realistic economic escalation rates, and the use of cost estimates that are invariably low and based on overly optimistic assumptions.

The first corrective step that must be taken is to restructure OSD and the Services' planning processes to ensure that only those programs that have a realistic chance of being adequately funded and completed are permitted to enter full scale development. Lower priority programs that now drain away scarce resources should be discontinued at a very early point in the acquisition cycle. There is little prospect of major defense budget increases as long as the United States is at peace. Without elimination of the low priority programs there is no chance of solving the funding problem.

A major part of the ability to properly plan procurement programs is based on accurate cost estimates. The cost estimating capability of each of the military departments appears to have improved in recent years. However, substantial further improvement is possible and is required to assist in the achievement of program stability.

Estimating the cost of developing and procuring complex weapon systems is inherently difficult and imprecise. However, official estimates of weapon systems have been characterized by a considerable downward bias in addition to the inherent imprecision. The creation of the Cost Analysis Improvement Group in 1972 resulted in improved cost estimates within OSD and also within the military departments. There now exists reasonably good correlation between the cost estimates of the military departments and OSD. Unfortunately, some of this agreement is deceptive in that the cost estimates of the military departments and OSD tend to be well below the actual cost of the systems. The reasons include:

a. poor cost estimating data base within each service and OSD;
b. limited interservice exchange of data;
c. insufficient supply of competent analysts;
d. insufficient time to perform the cost analyses;
e. low estimates of rates for economic escalation;

f. little or no allowance for system changes/improvements during the development and production period;

g. no allowance for development or production discrepancies caused by delays and stretchouts;

h. failure to include costs of training, logistics support, etc., and

i. pressure from program advocates to keep the estimates low.

It could reasonably be argued that some of the factors listed above are beyond the purview of cost analysis. However, the result is the same —— low estimates which contribute to program turbulence and to a credibility gap with those who must review and approve budgets and programs.

The Task Force believes the following steps should be taken:

1. Each military department should consider increasing both the quality and quantity of cost analysts. Their organizational placement should allow good access to the program managers but not cause them to be subject to pressures to create biased estimates.

2. A formal program to implement an exchange of cost data within and between military departments.

3. Acceptance of a cost estimating practice that makes an estimating allowance for normal program delays, and

an allowance for engineering and production change orders.

4. A practice of "freezing the design and alternatives" about three months prior to the (S) SARC) to allow the cost estimators time to complete their tasks. The Navy and Air Force should evaluate the Materiel System Requirements Specification process used by the Army.

Multi-Year Funding

Traditionally, most defense weapons programs have been authorized, and funds appropriated, on an annual basis by specific line items. There is no constitutional or statutory basis for this practice, rather it is based on Congress' perceived need to maintain its control over major fund expenditures. Unfortunately, the size, complexity, and long time frames of current defense programs require more flexibility than is permitted by an annual funding cycle, if significant cost reductions are to be achieved.

It is generally agreed by most government procurement officials and by contractors, that the uncertainties inherent in an annual funding cycle preclude contractors from making long-term production commitments that could result in lower costs. Volume purchases, economical contracts with suppliers, recruitment of a stable work force are all adversely affected. Furthermore, program uncertainty dictates against investments in plant and equipment (by both

contractors and the government) that could materially increase productivity. Lastly, the lack of multi-year funding permits both DoD and the Congress to make costly changes in production rates and to stretch programs out with resulting major increases in unit costs.

The Task Force believes that most major programs should be funded on a multi-year basis. It it recognized that this will require a change in perspective on the part of the Congress and that funding constraints will prevent the Congress from funding all programs on a multi-year basis in the short term. It is recommended, therefore, that for the short term, elimination of the current $5 million termination liability limit will tend to reduce some of the program uncertainty and encourage multi-year contracting. For the long term, it is recommended that DoD should seek legislation requiring multi-year funding for programs that will exceed three years and cost more than $1 billion, and for other programs as warranted by the priority and degree of risk involved.

Funding Flexibility

Coupled with the annual budget cycle is the fact that neither OSD nor program managers have much flexibility to make management decisions that involve increases, decreases, or transfers of funds among and between programs. The Congress, as well as management within the DoD, is reluctant to relinquish control over funds once they have been allocated to a specific program.

A greater degree of flexibility is required and it can be accomplished without a significant lessening of the controls now in place. The concept of mission budgeting appears to offer promise as a management tool to achieve the desired purpose. Congress could very well appropriate funds for a specific mission area, supported by specific programs comprising that budget, but permit DoD components to adjust funds for approved purposes within that mission area. Thus, management decisions on production rates, stops, starts, etc., could be made without the necessity for seeking reprogramming.

The Task Force also believes that program funding should include management reserves to permit program managers to quickly react to unanticipated events. The cost estimating process during the development phase and early production phase makes no allowance for a category of costs that will certainly occur. Failure to provide this cost allowance often causes cost growth.

Materiel acquisition costs can be viewed in two categories:

- o Those that can be foreseen and planned for, and
- o Those that arise in overcoming unexpected problems.

The latter category represents a not insignificant portion of the cost incurred in materiel acquisition activities. It is doubtful that "conventional" cost estimates can ever produce accurate results. "Conventional" cost estimates are defined herein as those based on listing all tasks known to be required and then assessing the cost of each of those tasks. It is suggested here that there is no manager alive with the prescience to project

(specifically) all the problems which should be expected during the lifetime of a major production program.

The need thus exists to make provision for the unforeseen---but statistically highly predictable.. .difficulties which invariably arise in major projects. One method for doing this is called Total Risk Assessing Cost Estimating (TRACE) which involves determining on a probabilistic basis the additional costs to be expected in solving unexpected problems. The key point is that the final estimate results in about a 50:50 likelihood (on a dollar basis) of either an overrun or underrun.

It has been stated that the Congress will never approve funds which might be identified as a reserve or "slush fund". This is probably correct. However, the Congress will (and does, in the case of the Army and the NRO) provide in the budget those funds which simply represent a more realistic cost estimation. There does exist, however, the need to avoid viewing the TRACE funds as a reserve...or budgeting them as a lump sum. Rather, they must be realistically allocated throughout the work breakdown structure and identified in the form of simply a more realistic recognition of anticipated costs.

Funds over and above those associated with specific foreseeable efforts should be held at a senior headquarters (Service or even OSD) and released to a program manager only if and when the need is fully justified. The program manager should be measured, as is common practice in commercial endeavors, by a cost goal

set specifically for him. In industry this generally is not the same figure as the budgeting figure carried in the company's financial forecasts...yet of which the program manager is fully cognizant.*

In summary, if unit costs are to be held down stability must be offered to the production program. In view of the near certainty that unexpected problems will in fact occur, some funding flexibility must be provided to overcome those problems. TRACE is one possible method for assuring, on the average, realism in production cost estimates and the availability of resources needed to work around unexpected problems.

The Navy and Air Force should review the TRACE concept for possible use.

There is one additional step that the Task Force believes could be taken to improve the funding flexibility problem---raising the Congressional limits on reprogramming. The current limits, $2 million for RDT&E programs and $5 million for procurement programs, were established more than 15 years ago and are not relevant in terms of today's program costs. The DoD inhouse administrative problems in justifying many small actions prior to submission to the Congress are a severe burden and add to the overall problem of program instability. It is recommended that, as a minimum, the current limits should be raised to $5 million and $10 million, respectively, or established as a percentage of a line item.

*The Task Force did not agree that these restrictions on program management responsibility were productive.

Recommendations

Long-term funding commitments are an essential ingredien of program stability:

- o In the short term, DoD should request the Congress to eliminate the arbitrary restriction on termination liability.
- o As a long-term objective, DoD should seek legislation that would require multi-year appropriations for production programs that
  - exceed three years and
  - exceed $1 billion,

  and other programs that warrant multi-year funding based on priority and level or risk.

DoD components must make concentrated efforts to achieve program stability by:

- o Planning procurement programs on the basis of affordability, reasonable budget levels, and cost realism.
- o Early elimination of lower priority programs.
- o Making "affordable rate" of production a key element in contract negotiations and acquisition planning.
- o Taking advantage of funding flexibility inherent in mission budgeting.
- o Providing adequate management reserves to take advantage

of cost saving opportunities and to respond to unexpected events.

- Requesting the Congress to raise the limits on reprogramming actions to $5 million for RDT&E programs and $10 million for procurement programs, or a percentage of line item value.

Appendix B

COMPETITION

Summary

The Task Force was requested to look at the potential of reducing unit cost through competition during Full Scale Engineering Development (FSED) and/or production, to determine the environment within which competition would be likely to reduce overall acquisition cost and, if feasible, to establish a methodology that could be used by DoD and/or the program manager to determine optimum use of competition in the acquisition strategy.

Data on the impact of competition was presented by the three Services, IDA and several industry sources. Information on development and production competition was reviewed and evaluated.

Very few completely valid examples were available to evaluate the effects of competition in development and the economic value of the competition in these developments is yet to be established.

Cost analyses by the Task Force were therefore made in lieu of availability of any substantive data of cost benefits of development competition. It was concluded that competitive development was unlikely to pay off unless substantial production rates over a long period of time were anticipated and the cost of development was a very small percentage of the acquisition cost. Development competition might, however, be warranted under unusual circumstances

where, for example, a high risk alternative might offer substantial reliability and cost advantages if the development were favorable versus a more conservative and costly design approach.

About a dozen or more examples of competition in production of major systems were examined. Generally, the programs were characterized by large production rates (1000s/yr.) over many years. Savings from competition frequently were estimated after the fact with inadequate data using varying techniques and tended to be highly subjective. Estimates of savings from 10-30% were indicated. Due to the subjective nature of the analyses, the Task Force believes the results were overstated. Nevertheless, realizable savings of 10-15% after a discounted return on investment should be feasible for production competitions involving systems of modest complexity, high production rates and many years of production. A mature data package was found to be essential and 4-5 years are required to establish the second source. Development of the acquisition strategy during Phase 0 and/or I should materially improve the process and reduce the time required to establish competition. Production competition of low production rate complex systems or subsystems does not appear desirable even if the production can be projected for many (5-10) years.

A methodology for determining optimum use of competition in the acquisition strategy was not completed by the Task Force. Actions

are underway by DoD with the assistance of the Task Force to achieve this objective.*

The following paragraphs provide more detailed discussion.

Competition in Development

Examples of competition in FSED were very limited (ALCM, GSRS, TADS are typical) at the system or major subsystem level and the bottom line on economic benefits still was not determined. Little had been done in these competitions in development to evaluate the competition viability in terms of discounted ROI (return on investment). Two more recent competitive developments are the Navy ECM pod and the Air Force JTIDS. The latter is especially unique in that each of the winning competitors in FSED will be required to qualify a follower under subcontract during FSED who will subsequently compete in production in a leader/follower arrangement. Again, no discounted ROI analysis has been made to show whether these program approaches are economically viable. All of the aforementioned programs need to be closely monitored for lessons learned by DoD or another appropriate source designated by DoD. All financial facets should be tracked to provide a data base for future competitions. Financial analyses concurrent with the competition should provide a running update on the benefits and costs of competition.

*Assuming that DoD accepts the suggestions for one experiment in competition and the use of Task Force members in a follow-up role.

Lacking any historical data, an attempt was made to analyze a typical missile program to determine if there would be an economic payoff in competing development to the same requirement. Neglecting the increase in government cost for managing two contractors, the increase in cost for two contractors in OT&E, and the discounted ROI for front end investment, there was a net increase in cost in acquisition for retaining two contractors in continuous competition based on an assumed 15% reduction in production cost due to competition. The two programs produced an equivalent unit cost to a single program if a 30% reduction in production cost could be achieved. This case study was for a tactical missile with 17,000 missiles produced and both contractors fully qualified on the first production buy. All of the assumptions were optimistic in favor of competition. The Task Force concluded that competitive development for cost improvement in acquisition was unlikely to pay off unless: a) the development cost was a very small percentage of the total acquisition cost; b) the system being competed was projected to have a long production run; and c) would be procured in large quantities. It recommended that DoD task an appropriate source to establish a nomogram for analyzing when competition will provide cost benefits and to gather appropriate cost data for various weapon systems types necessary for its use.

Special circumstances may offer potential cost savings via competitive development. This is discussed in the section, Special Cases for Competition.

Competition in Production

A dozen or more examples of competition in production were examined including TOW, Dragon, AIM-7, AIM-9, Walleye, etc. By and large, they represented programs where thousands of relatively low complexity items were produced over a long period of time. The data available for review was limited and tended to be highly subjective, particularly in regard to estimated savings. There was no uniform technique utilized for estimating the cost with and without the benefit of competition except in an Army Research Office report.* In most cases, analyses of the effects of competition were done after the fact rather than before the competition to provide the basis for an acquisition strategy. Data were generally lacking on the total investment cost for bringing a second source into being.

Typically, the investment cost will include costs for the data package, data rights, implementation of the second source, a learning quantity, qualification of the second source and his major subcontractor's qualification, Operational Test and Evaluation, if required, support by the initial source, additional costs to the government for managing two sources, etc.

*Determining and Forecasting Savings from Competing Previously Sole Source/Non-Competitive Contracts. Army Procurement Research Office, October 1978.

The minimum time to establish competition was three years with the norm four to five years with some as high as six years. In nearly all instances, the competition was "build to print" but "warrant to spec." which may be inconsistent. Advertised savings from competition varied from 10-30%. Due to the subjective nature of "what if analysis," there appeared to be a strong tendency to overstate the saving.

Nevertheless, it was the Task Force consensus that significant savings should be realized via competition in production. The conditions favorable to production competition were:

a) low to modest complexity
b) a mature data package
c) high production rate
d) long duration
e) viable sources with proven capability in the same or related product lines

Based on the above, a split buy, followed by a competitive buyout or winner take all when the end of production could be reliably forecast, provided a rational acquisition strategy.

With these conditions, net cost savings in production of 10-15% are believed to be realistically achievable after discounting initial investment. Other factors, such as maintaining a broad industrial base, increased surge capability, etc., also favor increased use of competition for programs where cost benefits of competition might be marginal.

Low rate production programs involving highly complex systems or subsystems did not appear to be appropriate subjects for production competition. Time and costs of establishing the second source, the difficulty of establishing an adequate data package and the major facility investment required mitigate against such competitions even though a production run of 10 years can be projected.

A number of observations are worthy of note. "Build to print" procurements severely limit the benefits of competition as does the tendency of the Service to freeze the design process once a mature design has evolved. An extreme example is the Navy AIM-7 where an outdated "cord wood" electronics design is still in production today, even though "cord wood" design became obsolete in the early 60s. Substantial production savings with improved reliability and maintainability, using modern electronic design, should have been feasible via a strong value engineering program. In contrast, the Army TOW program encouraged value engineering changes that improved both cost and/or reliability. This was more feasible with the TOW wooden round concept than with the more complex AIM-7. Nevertheless, the Task Force believes that opportunities to reduce cost are and will continue to be limited if an overly harsh "frozen design" approach is pursued. Appropriate selection of the level of interchangeability and repair early in the design process can provide a much higher level of flexibility to the producer. He then can exercise ingenuity in cost reduction compromising reliability, maintainability or support. These factors should be considered in Preliminary Design Review and Critical Design Review.

The Army and Navy, who had most of the experience in competition, both commented on the substantial increase in effort required to establish competition. They expressed concern regarding personnel resources if competition was too widely applied. Both indicated that the time required for verifying the data package and for establishing a viable second source reduced the number of opportunities significantly and that cost should not be an overruling factor (i.e., maintaining the quality of the product was a critical issue).

Frequently the initiation of competition has been instigated by dissatisfaction with the prime, using competition as a planned rather than long-term strategy to maximize the return for the government. The result of precipitious competition is that an adequate data package will not exist, data rights become a major issue, and an RFP must be generated in too little time. The substantial up front funding necessary for competition usually has not been established in the budget. All of the hurdles take time and money to correct. Clearly the acquisition strategy must be established up front per A-109 and 5000.1/.2 if these problems are to be avoided and optimum return for the government is to be realized.

Special Cases for Competition

Although competition in development is generally not economically viable except when the development cost is a very small percentage of the total acquisition, certain cases may mitigate in favor of competition. For example, a high risk but potentially lower cost and

more reliable system may offer sufficient cost saving potential in production to warrant competition in development versus a higher cost proven technology concept. Similarly projections of threat 10-20 years hence tend to be highly speculative at best. Designing a system to meet the highest projected threat potential can be very costly but it may also be necessary. On the other hand, a much lower cost design may be closer to reality in terms of the real threat when it is ready for production. Hence, in areas where the threat is clearly uncertain and the front end cost is affordable, a high/low mix may be a suitable course to consider.

Other specialized cases for competition include use of a competition with off-the-shelf products. Commercial airplanes, trucks, bulldozers, generators, etc., fall into the category as do commercial computers and electronic components. Drastic departure from Mil Specs will be required, and may be desirable.

Competition with off-the-shelf hardware, product capability improvement, or foreign military equipment are other forms of specialized competition versus new system designs. (See Appendix D for discussion of product capability improvements.)

All need to be evaluated at Milestones 0, I, and II.

Conclusions

It was concluded that production competition can reduce unit costs but that the product must be fully defined and there must be a reasonably high level of production planned. It was further noted that there must be substantially more "front end" investment planned if competing production lines appear desirable.

Full scale development competition was thoroughly discussed and it was concluded that it is useful only under special circumstances, probably limited to widely different concepts of systems. Full scale development competition clearly increases development costs and unless these costs are a very small percentage of the total program cost, the payback is doubtful. The Task Force found very little definitive evaluation by the Department of Defense on the real cost value of competition - particularly in the area of full scale development.

It has often been suggested that costs could be reduced if the military would use commercial products. It was found that, while this is an attractive idea, the application is difficult under current procurement regulations and logistic concepts. It appears that the military wants to "buy commercial" as long as it meets Mil Specs! This has little chance of success as a cost saving effort under these rules, but dropping the Mil Spec requirement (or the equivalent) may make a significant impact on unit procurement costs.

Appendix C

REQUIREMENTS AND AFFORDABILITY

Formulation of qualitative requirements for new military systems is a complicated process normally characterized by considerable interaction between the "user" and the acquisition community. The focus is on the need for and the characteristics of individual systems in comparison with a threat or threats. The subject of quanity is then brought into the evaluation process, usually by means of cost-effectiveness analyses. The costs are derived from quantities and production rates that are usually arbitrarily selected. At the very best, these early cost estimates must be greatly refined as the acquisition process continues.

Once the performance requirements are established, the coupling between performance and cost begins to weaken, and affordability, if considered at all, becomes a secondary criteria. This emphasis on performance, with cost considered as an unfortunate constraint, leads to continuing complexity and too frequent reliance on high technology. The Defense Department finds itself in an environment of being able to acquire small numbers of high technology equipments, whereas larger quantities of yesterday's weapons (or improved equipment) require more justification.

The requirements process does not include a vigorous treatment of such issues as the total quantity required and the budgets that could be available for the mission area over the next 15 years. Nor

does the process require quantity versus quality trade-offs within affordability constraints. As the acquisition cycle proceeds, Program Managers very seldom have the flexibility to make cost/performance trade-offs. By this time, the requirement has been carved in stone. There is minimal contractual flexibility to make cost/schedule/performance trades. Finally, there is little effort made in either the initial design or in the "changes" to encourage designers and engineers to place far greater emphasis on costs in production

Recognizing the inherent bias which leads to reduced procurement quantities, it is necessary to reconsider the present practices of establishing and adjusting requirements.

A more realistic approach should anticipate real world events such as cost growth, failure to achieve full spec. performance, and reduced program funding. Sensitivity analyses are often conducted to examine the impact of performance parameters on military effectiveness. But there is little, if any, examination of the sensitivity of military effectiveness to quantity changes. The situation can be improved by stabilizing the environment in which our programs operate. But the problem should also be approached from the other side, considering realistic perturbations in the program environment and ensuring that there are realistic cost reduction options that do not demand a reduction in the quantity of units produced. Beginning the program with less than ultimate performance in some subsystems--

with options for subsequent improvement--may be one way of reducing the bias which drives toward reduced procurment quantities.

There is a bit of folklore in defense acquisition that overstating requirements is a principal contributor to high unit costs. There are many horror stories that support this belief such as the terrain-following equipment for the C-5, -65°F. requirement for equipments used in the desert, etc., etc. A point that is often overlooked is that a requirement is not known to be overstated until the implied costs are finally known. Since there is a substantial period of time from the stating of a requirement to the development of credible cost estimates, the feedback of requirements versus cost or affordability is not made. This suggests that detail requirements should be viewed as "tradeable" until well into the acquisition process.

During the Task Force discussions several approaches were recommended that would lead to better assessment of the costs of requirements. One of these is to utilize contractor experience in scrubbing and analysis of "requirements" costs. The current draft version of DODI 5000.2 encourages such activity.

Increased utilization of the resources of industry offers considerable potential for planning programs with lowering unit production cost. The sooner industry's knowledge, experience, and inventiveness are focused on mission requirements and weapon system

definition, the greater the opportunities for significant cost reductions. Therefore, participation by industry should be actively solicited during the Concept Formulation and Weapon System Validation Phases (Phase 0 and I). The government should strongly emphasize that system cost is of paramount importance to the ultimate disposition of the program.

During Concept Formulation, direct involvement by industry should be directed to identify those mission requirements which are significant cost drivers; provide baseline cost/performance data for trade-off consideration; identify alternative concepts and the risks associated therewith; and recommend alternative programs.

During the Validation Phase, competing contractors should be contractually funded to discover less expensive alternatives and, in particular, to: identify those system and subsystem performance requirements which drive cost; provide cost-performance data for trade-off considerations; seek lower-cost subsystems, support, and training equipment; propose alternative logistic concepts; identify specifications, standards, data requirements, etc., which could be waived or altered in the interest of program economy; and determine cost effective program schedules.

There are three prime considerations in gaining effective participation of industry in lowering unit production cost:

Motivation: Industry will react to emphasis by the government when individual firms perceive that the government is willing

to reward industry's cost reduction initiatives. Therefore, industry must be convinced that emphasis on cost reduction is real and continuing--not just a passing fancy which will, in the final analysis, take secondary importance to maximizing weapons system performance. Since competing producers may be reluctant to reveal proprietary innovations, non-hardware study contractors may provide additional (but not exclusive) early (pre-validation phase) ideas.

Timeliness: Contractors should be funded for performance of cost reduction studies as early as possible during Concept Formulation and Validation Phases. Opportunities for significant cost reductions are greatest during these phases. Relatively small sums expended during the early phases may return large dividends during the total program life. Sound recommendations, even if they involve ground rule changes, received early from actual or potential contractors must be protected from disclosure if they involve loss of the firm's competitive advantage.

Formal Process: To insure that inputs by industry are properly considered--and to emphasize the importance of cost-reduction to industry--a formal process should be devised to evaluate cost-reduction proposals. This process should be administratively simple and involve senior Service and DoD officials.

To provide a serious review of requirements from the affordability viewpoint, the Task Force recommends that an independent

group be established to audit requirements and to provide inputs to the Service SARCs. Such groups would be divorced from the advocacy role and would assess requirements to determine affordability, whether they are overspecified and whether the cost estimates are credible. It is suggested that they be called "PARE" teams (Program Affordability Requirements Evaluation) and that they report at a high enough level to be relatively free from advocacy pressures.

In summary, the Task Force concluded that much can be done to bring affordability considerations into the requirements process. "Tailoring" has been suggested for acquisition strategy and for specs and standards. It is time to start "tailoring" requirements.

Appendix D

PRODUCT CAPABILITY IMPROVEMENT

Product improvement has been a way of life for the DoD for many years. Improvements may be introduced to increase performance, increase reliability and maintainability, reduce production and O&S costs, correct deficiencies identified in the field, meet new threats or to support changes in tactics and force structure, and, finally, to extend equipment life. The most important of these improvements affecting decisions on new system starts is the "product capability improvement."

Improvements may be achieved by modification of existing equipment or in long production runs by model changes in new procurements. Capability improvements often consist of replacing subsystems on platforms (ships, aircraft, armored vehicles, etc.). Table I is a list of DoD equipment currently in the inventory or being procured/modified which reflects capability improvement over the orginally procured equipment. Such evolutionary improvements often occur over more than twenty years and reflect several increments of change. It can be seen that the list is extensive and covers almost all categories of major weapon systems except for ships. In the case of ships, whose hulls intrinsically possess a long service life, conversion to improved capability in the overhaul cycle is, and should be, regularly scheduled.

Reference to Table I discloses that the DoD product improvement programs must be counted an an important and cost-effective part of the weapons system acquisition process.

TABLE I

PRODUCT IMPROVED CAPABILITIES (MODS AND NEW PRODUCTION)

E-2A	--	E-2B,C	P-3B	--	P-3C
A-6A	--	A-6E	AH-1	--	AH-1S
A-7A	--	A-7D,E	CH-47	--	CH-47D
B-52	--	B-52,G,H	CH-53	--	CH-53E
F-4B,C	--	F-4J,D,E,G	M-60A1	--	M-60A3
C-130	--	C-130E,H	M-48	--	M-48A5
C-141	--	C-141 (STRETCH)	M-109	--	M-109A1
A-4	--	A-4F,M	HAWK	--	IMP HAWK
F-5	--	F-5E	A1M-7D	--	A1M-7E,F
U-2	--	TR-1	A1M-9B	--	A1M-9E,G,H,J,L
F-111E	--	F-111F	MM-1	--	MM 11, 111

PRODUCT ADAPTATIONS

STD MISSILE		STD ARM
SPARROW (A1M-7)	--	SEA SPARROW
A1M-9		CHAPPARAL
VULCAN (M-61)		VULCAN AAA

Of late, because of the increasing average age of much of the DoD equipment, modifications to increase service life have been taking large fractions of the service mofification budgets. Often some capability improvements accompany service life extension programs. Table II illustrates the growing magnitude of the Air Force budget estimates for aircraft modification including product capability modification versus new procurement. For FY 80 and 81, modification funds are 40 and 51 percent respectively of new procurement funds. At this level of procurement it is obvious that such programs be subject to the same rigorous cost analysis as new programs and that product capability improvements be analyzed simultaneously to assure that "down time" of systems be economically utilized.

Product improvement programs have generally not been given the same degree of consideration and support as new system contenders for the same mission. This, in spite of the fact that established service requirements and MENS procedures now generally call for such considerations. Too frequently product improved systems have been resorted to only as a "fall back" from a preferred new system. In fact, improvements to existing systems have sometimes been considered a "threat" to new system approval and funding and have been suppressed for periods of time for this reason. Thus, product improvement systems have usually not been optimally planned and scheduled, have not been regularly considered as alternatives to new system starts, as elements of high/low force mixes, and as a means of stabilizing force modernization.

To achieve these ends it appears necessary to generate a higher level of advocacy and support for product improved systems as viable system/force structure alternatives in the MENS, DSARC, and PPB processes.

Recommendations

- o A "product capability improved" alternative should be included in the DSARC and PPBS.
  - -- Advocacy for "product capability improved" systems should be established in the services and OSD at senior levels.
  - -- Emphasize and monitor routine evaluation of "product capability improved" systems as alternatives and as high-low mix elements, explicitly comparing cost, effectiveness, risk and schedule of upgraded existing system vs. new system.
  - -- Assure consideration of a "product capability improved" system alternative as a response to each MENS (include adequate R&D funding for this purpose).
  - -- Fund product capability improvements in parallel with new system development where merited.

TABLE II

AIR FORCE

NEW AIRCRAFT VS MODIFICATIONS

($ IN MILLIONS)

	FY 75	FY 76	FY 77	FY 78	FY 79	FY 80	FY 81
NEW AIRCRAFT	$1,532	$2,517	$3,638	$3,960	$4,054	$3,919	$4,037
MODIFICATIONS	517	700	685	652	948	1,575	2,046
PERCENT MODS	34	28	19	16	23	40	51

SOURCE: AIR FORCE BRIEFING TO DSB SUMMER STUDY

Appendix E

THE USE OF TAILORED PROGRAM MANAGEMENT

As the number of specifications, standards, and regulations have grown, all of which must be accounted for or implemented by Program Managers, so have the number of detailed acquisition directives and demands for program oversight for which he is accountable to seniors in the services or elsewhere. The sum of all these documents and directives is now so great that virtually no one person is aware of the totality. The oversight requirement has led to great quantities of paper, considerable travel, and a need for large program staffs.

In examining this framework of directives it is well known that there are over 40,000 specifications and standards. At the same time there are over 130 DoD directives and instructions affecting acquisition management. These in turn are further embellished by each of the Services (secretariat, Service chief, logistics commander, system command). Taken singly each directive may have virtue, if only as a defense against program critics but certainly all need not be taken into account by each DoD Program Manager. What must be considered is the process and the ultimate defensibility of deciding not to apply each directive in the same way to each program. For example, detailed studies of specificationns and standards conducted over the last several years have concluded that while the number of these documents is large, there is not a large number of unnecessary documents when viewed in terms of the magnitude and diversity of systems required for defense. There is, and has been, good agreement that it is the application of directives, rather than their existence, that drives

acquisition time and program costs. The primary impact on program cost seems to be related to development programs rather than on unit recurring cost. There is evidence, however, that over-application of some directives and demands for oversight can impact even these recurring costs.

The studies indicate a growing need to codify our acquisition directives, limit the demands for program information, and to permit a Program Manager to "tailor" his project after taking into account the management structure both "up"and "down." The Deputy USDR&E (Acquisition Policy) has undertaken efforts to reduce the number of DoD directives and, where feasible, to incorporate some of them into the Defense Acquisition Regulations. This effort should be continued and should be expanded to those directives issued at the Service level and by others. Program Managers are already required to tailor specifications and standards and are authorized to modify or delete other lower level documents. These P.M.s are not specifically authorized to deviate from the higher level directives. In fact, the range of activities associated with these higher level acquisition directives is highly dynamic. On the one hand the activities are largely intragovernmental and related to the overall management process, but on the other they tend to both impact and diminish the contractual relationship between Project Manager and contractor. A process for deviation from particular higher level directives should be developed to allow the Program Manager to make timely acquisition decisions, allowing contractual actions to be completed, funds to be released, etc. Program Managers should be both permitted and required

to tailor both major and non-major programs so that a streamlining of the acquisition management occurs. For programs under OMB Circular A-109 it is especially important that they not be strapped with the full requirements of the acquisition process before DSARC II. For example, the full cost of implementing the Cost and Schedule Control System (CSCS) should not be forced on programs if adequate visibility is available through simpler, cheaper means. Nor should enthusiasts for competition demand a complete MIL-D-1000 reprocurement data package unless, in fact, there is agreement at all levels that there is a mobilization base requirement or sufficient economic analyses to justify later competition. NATO RSI and metrication considerations should not demand extensive analyses by both the contractor and government manager unless there is firm reason to believe that they are applicable. The list can be made longer but the point is that the day-to-day manager must be allowed to exercise judgment in fitting his program to the acquisition structure, without overbearing pressure from segments who are interested in only narrow pieces of the acquisition process. The extent of tailoring will range from practically none on major programs of high national interest, to a streamlined skunk works on less visible programs of high priority. It follows, of course, that the tailoring is not a unilateral action but a planned part of the acquisition strategy identified in the program charter suitably approved at the onset of the program.*

*The draft version of DoD I 5000.2 dated 17 October 1979 takes an almost directly opposing approach. "Tailoring" is defined to require the Program Manager to comply with all DoD issuances. There is no provision for deviation.

Stability in retaining the government manager deserves continued emphasis because it is central to overall program stability and therefore related to program costs. Further, the same level of stability should be sought in retaining industrial managers and in key staff members of both government and industry teams. These key players should not be subject to casual reassignment. It is recognized that in some cases promotion and retirements must be permitted.

Recommendations*

-- The Services should develop a list of candidate programs to use a streamlined or tailored program management. For each program the Program Manager should develop a streamlining charter detailing his or her explicit management authority based on the program's unique objectives.

-- USDR&E should obtain PA&E, MRA&L, and ASD/C concurrence in the streamlining concept and concurrence on specific program charters. Program Decision Coordination Papers (DCPs) should be revised to reflect the approved management charter.**

*These recommendations are not specifically included in the report, since the Task Force did not develop a consensus - not because of disagreement, but because of time constraints.

**The necessity for all of these actions by today's rules is illustrative of the problem to be solved.

-- The Services and USDR&E should "set aside" these tailored programs for separate review during the POM and budget cycles. The funding should be protected and clearly identified for approval by the Service Chief of Staff, Service Secretary, and SecDef and an accurate accounting of cost performance must be made to demonstrate, if possible, that substantial savings have resulted.

Appendix F

EXAMPLES OF EARLY INVESTMENT LEADING TO REDUCED UNIT COSTS

Large improvements in the reduction of unit cost can be achieved through application of latest technology in factory management systems, machinery, Computer Aided Manufacturing (CAM), Computer Aided Design (CAD), and the unification of the two in CAD/CAM. Improvements in productivity of two-to-one or more are not unusual and have been demonstrated in the commercial sector. Such two-to-one improvement could result in complete production cost reductions of 15 to 25 percent. Results also depend upon the base system to which the technology is applied.

A problem in applying this to military programs is that it must be initiated prior to the production award. Depending on the base, such application must be started two or three years before production award and represents serious investment in man power and equipment resources, a substantial portion of which is capital investment.

While manufacturing technology does play an important role, the situation being addressed here goes far beyond MAN TECH and really is "preparation for lowest cost programs". Items necessary are:

Factory Management Systems.

This relates to the complete computerization of the factory and supplier base to meet schedule, minimize inventory, and reduce man

hours. New technology systems are applicable both to mature programs having few changes and programs undergoing extensive developmental or improvement changes. Introduction time, depending on the base, could be two or more years. Waiting until production commitment essentially rules out such system improvement for the many programs.

Machinery.

Numerically controlled machinery is common in U.S. factory production. However, in recent years substantial improvements have been made and, in many cases, older machines are not convertible. Furthermore, the newer machines are receptive to the CAD/CAM data base described below. Machines such as multi-function mills and multi-function automatic riveters cost $2 million to $7 million each and have lead times of two years or over. For program efficiency they must be in place, tried out, and fully integrated into the system before production is started.

CAD/CAM

Computer aided manufacturing is simply a next step in the CAM process participated in by most U.S. manufacturers. Computer aided design, on the other hand, is a new system being practiced by few U.S. companies.

In CAD the engineer works with a computer terminal and so-called "interactive graphics" equipment to design structure and some systems without the use of drawings. Should drawings be desired, a specialized machine can make them without the use of engineers or draftsmen.

Such CAD requires both equipment and training. Training must take place at both engineer and management levels. Age has not been found to be a constraint. However, again, investment is substantial and must be done well ahead of production commitment.

The end result of CAD/CAM is the use of a computerized data base into which engineering concepts and designs feed and from which tooling and production take data to fulfill their functions. This base substitutes for the past drawings and supporting documents and affords substantial productivity improvements and cost reductions.

Early investment to achieve these capabilities directly and powerfully drives toward reduced unit cost. Direct early funding of contractors to prepare for production prior to production program award, would pay large benefits in improved productivity and lower costs.

Appendix G

USE OF COMMERCIAL PRODUCTS

The demands of non-military consumers, because of the enormous market they represent, are a powerful driving force toward new technology. In contrast, military policies often lead to repeated long-duration procurement of products in which design changes are not permitted. As a consequence, some non-military technologies are advancing much more rapidly than military technology.

Certain electronic device fields are dominated by commercial demands rather than by those of the military market. Consequently, commercial products are evolving with increasing performance at attractive prices. Examples abound - sophisticated LSI chips, microprocessors, computer peripheral devices, display consoles - and many more.

The DoD has recognized this trend and, in fact, in certain procurements has encouraged contractors to utilize commercial products, especially when their availablity is "off the shelf" and the price is low. Unfortunately, recent experience in accomplishing this has highlighted several problems. The main problem is that the various procuring organizations are not equipped and in some cases are not even allowed to fully utilize commercial products. For example, even though a product exists and may be physically available, contractors are still forced in many cases to generate Part I and Part II product specifications and subject these specifications to

preliminary and critical design reviews. Having a design review on an "off the shelf" existing product is a contradiction in terms.

Another problem is logistics. The conventional military method of providing logistics support is to gather an essentially complete data package which would allow the government to have that item manufactured by another firm. This procedure is nearly impossible to implement with most commercial products. In the first place, the commercial firm normally does not have the kind of data required by conventional military logisticians. In fact, they are usually not even interested in preparing the data even if they are paid for it. A question of proprietary data rights is encountered with many companies. Further, the technical manuals that are normally supplied with commercial equipment are generally considered to lack sufficient data by the Government Procuring Agency for reasons that are not entirely clear.

The most serious difficulty, however, is the inability of the military logistics system to handle support of multiple product configurations that arise as designs are improved by the manufacturer. Providing spares can often be a major problem, as products change, go out of production, or when companies go out of business.

There are steps that can be taken to create an environment in which commercial products can enter the system - some of these are:

-- Scrub requirements and specifications to banish demands that unnecessarily exclude commercial products.

-- Use end-item specifications covering form, fit and functional requirements (including environmental and reliability requirements, if required) and eliminate nonessential subordinate specifications and standards.

-- Develop a mechanism for testing and qualification of commercial equipments to commercial end-item specifications.

-- To permit continuing product improvement, eliminating government controls on internal configurations of commercial products.

-- Use manufacturer service life policies (long-term contractor maintenance warranties) as alternative to organic repair to reduce the difficulty of maintaining multiple commercial designs.

Appendix H

TEST AND EVALUATION

(Note: This subject was not explicitly considered by the entire Task Force during the study because of time constraints.)

The emphasis on testing and evaluation has increased greatly over the last decade leading both to a special office within OSD and to the creation or augmentation of independent Service test agencies. DoD Directive 5000.3 provides the basic policy direction for testing and evaluation within DoD and each of the Services has its own directives to carry out this policy. The genesis of the "new" emphasis on testing derived largely from the perceived low operability and utility of systems already fielded. There was, and is, a general and accepted thesis that if better operational tests were conducted that poor performers would be weeded out or at least made operable before introduction to the operating forces. This increased emphasis on operational testing and evaluation (OT&E) has paid some dividends in increased reliability, maintainability and availability although operational utility was not fully achieved in many cases.* Incidental to the renewed efforts on OT&E has been an

*It was suggested by several that in spite of the national effort to achieve operational utility through test, it is now apparent that real utility is not achieved until the operators that use the systems have fulfilled the functions of first deployment and uncovered the real shortcomings that dictate necessary changes.

increase in developmental test and evaluation (DT&E) and in the investment in test resources. Each Service maintains facilities under the Major Range and Test Facilities Base (MRTFB) with an annual DoD aggregate outlay of several hundred million dollars for maintenance. Thus, there is still much preoccupation with field testing, both developmental and operational, and current acquisition directives and program reviews reflect this. The net effect of this emphasis has been to expand the front end costs of programs. Additional costs are accrued because of the judgmental aspects of the evaluation of the test results and concomitant program delays or added expenditures as one advocate or another demands more or different testing. What has not emerged is a method for defining the "knee of the curve," or the incremental value of additional testing, or when just enough testing has been done. Suffice it to say that this will be difficult to change but it should be acknowledged that large "front-end" costs for T&E are now a part of the acquisition structure. Despite this investment it should be noted that DT&E and OT&E is fundamentally an information gathering process to reduce risk, not unit recurring cost. While it is probable that field testing in many cases leads to changes that reduce unit costs it is also likely that there are other test-related changes equivalent to "new requirements" that add to unit recurring costs. No real assessment has been done, however, to validate this contention.

There is considerable non-field testing accomplished to support the acquisition process. Most of this testing lies outside both the interest and visibility of the upper level decision making process.

For example, tests such as environmental evaluation tests, reliability demonstration tests, maintainability demonstrations, and configuration proof tests are visible to both the government manager and his industry counterpart. Although the results of these tests are an accepted part of the process and their costs identifiable they play little role in high level decision making. The area of production-related testing, however may not be readily visible to either the government or industry manager. This testing tends to be strongly related to the complexity of the system, its design, and the production philosophy of the contractor. The degree and form of testing to ensure production yield and replicability will usually not be fully visible until moderate to large scale production is attempted, since the team that designs the system is almost invariably not the team that must produce it. In some cases it becomes apparent that the design requires extensive testing just to perform and verify the adjustments to make the system basically operable while in other cases the design itself inhibits economical testing or requires test procedures that are hostile to the unit under test. The costs of initial testing and testing after repairs can also contribute to unit costs, both in terms of capital investment and labor hours, but these costs are usually embedded in "manufacturing" data and are not easily captured except at the detailed cost level.

There is a requirement for an early marriage of the design and production process. Each program must consider its production philosophy early and it must be a part of the overall acquisition

strategy. If there is to be component, module, and subassembly testing sequential to end article testing then this must be prescribed and known to both the designer and the production manager. If automated testing is likely then this and its associated capital investment (and amortized contribution to unit procurement cost) should be acknowledged early and receive continuing consideration during the design process.

Finally, lot acceptance testing varies among systems but also varies between the services. In many systems the acceptance tests are so severe that they preclude later use of the article for Service use. In other cases, actual flight testing is a part of lot acceptance testing. The costs of lot acceptance testing have not been quantified but it is likely that the procedures are amenable to both standardization and reduction in cost.

Recommendations (no consensus by the Task Force)

-- USDR&E require a production strategy, including production testing, as part of an overall acquisition strategy.*

-- DUSDR&E (Acquisition Policy) examine Service lot acceptance procedures with a view toward codifying and eliminating lot acceptance testing unless fully justified and essential.*

*The Program Manager should be responsible for the cost/benefit trade-offs and for determining extent of production and acceptance testing.

Appendix I

AWARD FEES AS INCENTIVES FOR REDUCING UNIT COST OF EQUIPMENTS

(Note: This subject was not explicitly considered during the study because of time constraints.)

Award fee contract provisions allow a fraction of the total contract fee to be based upon a subjective judgment of contractor performance. As usually practiced, a floor and ceiling on fee are fixed and the award provision operates within that range. A number of review points are established spanning program life at which evaluations are made and an award paid (or not paid) to the contractor. The amount of the award made is determined by a board set up by the Program Manager using criteria either of its own choosing at the award period, or established by the Program Manager at the start.

Award fees have been applied extensively by NASA in both development and production programs and to a lesser extent by the Department of Defense primarily, but not exclusively, in development programs. As applied to development programs, the flexibility of incentive that award fee practice provides has found many strong adherents. Through its use it is possible to motivate a complex of responsive behaviors that would be difficult or even impossible to achieve within the rigorous definitions that are needed for the administration of incentive fee contracting.

While the technique has so far only been found useful in development programs there is reason to believe that it can be a useful tool in incentivizing the reduction of unit costs of military hardware. By including award fee provisions the Program Manager can reward design changes, simplifications, or improvements in manufacturing efficiency that result in reductions in unit costs. Reducing unit cost incentives it can be applied in either the development or production phases of a program, or both. By this method it is suggested that the contractor's attention can be kept better focused on cost considerations in both the design and manufacturing process. Such potential awards could provide incentives for investment in new manufacturing equipment, revision of procedures or introduction of new materials and designs that would not be attractive under normal Value Engineering provisions.

It is important to bear in mind that fee provisions can supplement or augment the incentives of continuing or expanding business (sales) and continuity of employment but are powerless to offset the negative effects of declining sales or employment. Therefore, any savings in production unit costs resulting in the application of award fees to incentivize them are best turned back into increased buys of the item from the producer achieving the savings. This type of reinforcement is of as much value as the application of the award fee itself.

Experience with incentive fee contracts has produced some results that may well carry over to award fee arrangements. Specifically, incentives tend to operate over a rather narrow range of circumstance. If a program is "in trouble" the incentive fee structure does not work because its effect is swamped by fears of termination, concern about technical aspects of the problem, and career hazards on both the customer and supplier sides. On the other hand, if the program is in good shape, once the incentives are earned (or can safely be predicted to be earned) they cease to operate to encourage any increased movement in the favored directions. The award fee case is in general, different since potential fee improvement can be a continuous incentive until program completion (and even after in the case of reliability in the field).

Appendix J

USE OF TEST BEDS

Industry does test marketing all the time to test product concepts and configurations against real world customer environments. Test marketing is used to establish what is useful and what is not; what is "must have" vs. "nice to have." It is an essential function when one designs-to-cost. The key factors in test marketing are:

- o A product test bed.
- o A very close working relationship between developer and customer.
- o Developer and customer jointly working with the product concept, via the test bed, in the field, on the customer's terms.

The above criteria rarely form a self-consistent action plan in the DoD. In industry, only after the test bed is fully assessed in the above manner is the real product engineered and developed. Some examples of how test beds and test marketing might be used in the DoD are:

- o C^3--We wouldn't design an airplane without a wind tunnel or test flights, yet we design C^3 systems and buy them without hands-on user interaction with a C^3 test bed.

- Armored Vehicles--What are the trade-offs among mobility, agility, silhouette, rate of fire, etc., on armored vehicle survivability. What should the horsepower-to-weight be for a tank? Why? How much do increments cost?

Obviously, test beds are not universally applicable, but the customer will usually ask for the world in any product that he hasn't "played with" on his terms. Why not, where it is feasible, get developers and users together in controlled "free play" with test bed or brass board hardware, to establish and prioritize that which is important, before we get into an expensive final development?

It is suggested that there be more emphasis on test beds that are "test marketed" by the users. This means a close cooperation between the test bed developers and the users in evaluating the concepts embodied in the test bed in a quasi-field environment. The armored vehicle test beds developed by DARPA and evaluated at Fort Knox are an example. Such tests provided user feedback on deployment and tactical alternatives, and established a base on which to do technical and tactical trade-offs.

Section III. BACKGROUND
(Appendices K through M)

THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

7 JUN 1979

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Defense Science Board Summer Study: Reducing the Unit Cost of Equipment

The unit cost of defense equipment is growing at a faster rate than the DoD budget. For example, the unit cost of fighter aircraft has grown at a rate of almost 10% per year over the last two decades while DoD procurement outlays have remained roughly the same in real terms.

We have but three alternatives in the face of these trends: 1) reduce the number of systems procured, 2) reduce the rate of growth in unit acquisition costs, or 3) extend the lifetime of systems in the field to defer costly replacement. The first alternative is our common practice. I would like the Defense Science Board to realistically examine the latter two in the context of DoD system acquisition.

The DoD has looked at the acquisition process and cost reduction many times; we don't want to repeat that work. However, in 1977, R&D and procurement were merged under the USDRE as the Acquisition Executive, offering improved opportunities to apply R&D to reduce unit procurement costs. But in reducing unit recurring costs, we need to take care that we do not increase the cost to operate and support the equipment once it is in the field.

R&D often represents only a small fraction (10 to 20 percent) of the total program cost; therefore, means for reducing production cost should be included in the R&D program, if sufficient potential can be demonstrated. In commercial programs, R&D aimed specifically at reduction of unit cost is routine. Why is this not true in DoD?

It is clear that, in order to reduce unit cost, we need to consider cost in the specifications for, and the selection of weapon system concepts prior to the development cycle. The requirements process should explicitly consider quantity versus quality of equipment. Some recent tests suggest that the quality of U.S. equipment is not making up for numerical deficiencies. We must provide incentives to the requirements process to prevent gold-plating and reduce recurring costs, so we can buy new equipment in larger quantities that better support total force capability.

We should review the DoD procurement process to assess the incentives and disincentives to reducing unit costs. Are DoD directives, contract procedures, and organization antagonistic to reduction of recurring costs? Are our R&D programs bypassing the problem? What should we do? The use and structure of competition would appear to be a central element.

Fitting improved subsystems in on-going production, and back-fitting on existing platforms to improve performance and extend useful life is another way of reducing the acquisition cost of modern equipment.

I request the DSB to examine the various alternatives for reducing unit cost, separate fact from fiction, and identify key actions that the DoD can take to reduce the unit cost of equipment so that we can maintain our military capability with relatively fixed resources. In particular, address the following questions:

-- What has caused the increased unit cost of equipment?

-- What incentives can be provided to the requirements process to emphasize reducing recurring acquisition costs?

-- How should we use technology to reduce cost?

-- What can we learn about designing for low-cost production from the commercial sector where cost is dominant (e.g., the automobile industry and the integrated circuit industry)?

-- How should we make better use of low unit cost commercial components to reduce the cost of military equipment?

-- When and to what extent should competition be used to reduce recurring cost?

-- What features of current specifications, directives, regulations, and contracts are most responsible for increased cost, and how should they be changed to reduce recurring acquisition cost?

-- How should life extension and subsystem modernization be integrated into a long-term acquisition strategy?

I am sponsoring this task. Mr. Willis Hawkins, Senior Vice President for Aircraft, Lockheed Corporation, has agreed to serve as Chairman; and Dr. Paul J. Berenson, Deputy Assistant to the Secretary of Defense for Atomic Energy, will act as Executive Secretary.

William J. Perry

Appendix L

LIST OF BRIEFINGS

This appendix lists the briefings given to the Task Force either in plenary session or during panel meetings. In addition to the briefings listed, informal discussions were held with General John Guthrie, USA, Commanding General, U.S. Army Materiel Development and Readiness Command, and with Admiral A.J. Whittle, Chief of Naval Material.

Copies of the presentations (where provided) are in a file at the Defense Systems Management College, Fort Belvoir, Virginia, Attn: Mr. Fred Kelley.

BRIEFINGS TO DSB TASK FORCE PLENARY SESSIONS

Subject	Presenter(s)
Perceptions on the Causes & Effects of Cost Growth	Wayne M. Allen, Director of Cost Analysis, Office of Comptroller, Army
Electronics X - IDA Study 1973	Howard Gates - Consultant
GAO Findings of Past Work	Jerome H. Stolarow, Director, Procurement & Systems Acquisition Division, GAO
Navy - Marine Corps Acquisition Review Committee Report (1974)	Richard Garretson, Headquarters Naval Materiel Command
Perceptions on Cost Growth in USAF	A. Boykin - Consultant
DSB Acquisition Cycle Task Force Study (DeLauer - 1977)	Robert G. Gibson Lockheed Missiles & Space Co.
Cultural Incentives and Report on "Little Four" Study	Leonard Sullivan, Consultant
Affordability	Paul J. Berenson, OATSD(AE)
DSB Report - Reducing Costs of Defense Systems Acquisition (Bucy - 1973)	John E. Steiner The Boeing Company
Test & Evaluation - AEGIS System	RAdm. W. E. Meyer, USN AEGIS Program Manager
DARCOM Study "How to Improve the Acquisition Process"	John D. Blanchard, Asst. Deputy for Materiel Development DARCOM

Subject	Presenter(s)
Air Force Systems Command Initiatives	MGen. James W. Stansberry, USAF DCS (Contracting & Mfg), AFSC
The TOW Story (2 Presentations)	Col. N. Williamson, USA Project Manager, TOW-Dragon J. Jorden, Hughes Aircraft
Views of Gordon Rule	Gordon Rule, Consultant
HARPOON Weapon System	RAdm. C. P. Ekas, USN (Ret.) Boeing Company
The F-5 Program	M. G. Gonzalez Northrop Corporation M. Kuska Northrop Corporation
Acquisition of Major Weapon Systems - Lessons from RAND Research	Michael D. Rich The RAND Corporation
CAIG - Status of Cost Estimating	Col. L. Yortee, OSD
Applying Commercial Practice to Military (Aircraft)	John E. Steiner, Boeing Company
Applying Commercial Practice to Military (Automobile)	George Huebner, Consultant

BRIEFINGS TO DSB TASK FORCE PANELS

Mission Element Need Statement (MENS)	Lt. Col. D. A. Lopes, USAF OUSDRE(PP)
US ROLAND - Transfer of Foreign Systems	Mr. Hoyt Harris Deputy Project Manager ROLAND Redstone Arsenal Dr. R. Roderick Hughes Aircraft
SEA MOD - Combat System Architecture	Capt. Holloway, USN Naval Sea Systems Command
Progress Report on Implementing Recommendations - Tailoring Specifications	John A. Mittino OUSDRE(SS)

Subject	Presenter(s)
Specifications and Standards	Joseph F. Shea Raytheon
A Policy for Defense Reliability and Maintainability	John A. Mittino OUSDRE(SS)
"Buy Commercial" A Policy for Acquisition and Distribution of Commercial Products (ADCP)	John A. Mittino OUSDRE(SS)
Profit Policy	David M. Koonce OUSDRE(CP&F)
Modifications and Product Improvement	Col. Graham S. Byrnes, USA Headquarters, DARCOM C. D. McElhanon Office, DCS Logistics, USAF Ms. Mary Padgett, Cdr. Wm. Arnold, USN, A. P. Cowles — Naval Air Systems Command
Revisions to DoD Directive 5000.1 & DoD Instruction 5000.2	Capt. Brady M. Cole, USN OUSDRE(AP)
AC-47, C-130 Gunship	Col. James Wolverton, USAF (Ret.) Honeywell, Inc.
MK 92, Fire Control, Mk 75 Gun	Cdr. Wayne Chadick, USN Naval Sea Systems Command
Examination of Cost Growth During Development Phase	Richard Trainor, Consultant
Impact of Competing Previously Sole Source/Non-Competitive Procurements (ARPO 709)	Paul Arvis and Everett Lovett Army Procurement Research Office
The Effect of Price Competition on Weapon System Acquisiton Costs	James A. Schuttinga Institute for Defense Analyses
Competition in the Acquisition of Major Weapons Systems	LCdr. Benjamin R. Sellers, USN Navy Postgraduate School LCdr. Dennis S. Parry, USN Naval Air Systems Command

Subject	Presenter(s)
Joint Cruise Missile Project	RAdm. Walter M. Locke, USN Director, Joint Cruise Missile Project
The AIM-7 Competition	Capt. James H. Quinn, USN Naval Air Systems Command
The General Dynamics Sparrow AIM-7F Story	R. A. Nesbit Pomona Division, General Dynamics
Navy Design to Cost Programs	Richard Garretson, Headquarters Naval Materiel Command
F-16 Design to Cost	J. Bair Aeronautical Systems Div., USAF
Army Design to Cost (XM-1, UH-60 Copperhead)	Rob R. McGregor Office of Comptroller, DARCOM

Three presentations that were scheduled could not be given because of time constraints. Copies of the viewgraphs are in the background data compiled for this study. These were:

Subject	Prepared By:
The Maverick Program	James Drake, Hughes Aircraft
Recent Aircraft and Avionics Cost History	James Drake, Hughes Aircraft
ESD Reducing Unit Cost Study	John Orphanos, Air Force Electronics Systems Division

Appendix M

BIBLIOGRAPHY

Reports

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dated January 1975

Army Materiel Acquisition Review Committee
dated 1 April 1974

OSD Acquisition Advisory Group
dated 30 September 1975

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dated 15 March 1978

DSB Study - Reducing Costs of Defense Systems
Acquisition - "Design to Cost"
dated March 15, 1973

Electronics X - A Study of Military Electronics
with Particular Reference to
Cost & Reliability - Howard Gates,
Institute for Defense Analysis
January 1974

Defense Resource Management Study
February 1979

Tailored (Streamlined) Acquisition Management

DCS, Research Development and Acquisition, HQ USAF
July 1979

Competition in Acquisition of Major Weapon Systems:
Legislative Perspectives - Michael D. Rich,
The Rand Corporation - November 1976

Determining & Forecasting Savings from Competing
Previously Sole Source/Non-Competitive Contracts
E. T. Lovett & M. G. Norton
Army Procurement Research Office - October 1978

The Department of Defense:
Statement on Major Weapon System: Cost
Estimation and Control - The Honorable
Charles W. Duncan, Jr. - Dep Sec Def.
26 June 1979

Proceedings of a Seminar Series on Cost Considerations of Military Systems Acquisition, Edited by C. A. Fowler and F. W. Hopkins The MITRE Corporation - March 1978

The Effect of Price Competition on Weapon System Acquisition Costs - G. Daly and J. Schuttinga Institute for Defense Analysis - 1979

Competition in the Acquisition of Major Weapon Systems. LCDR B. Sellers & LCDR D. Parry An Issue Paper - 31 July 1979

An Overview of Acquisition Policy Effectiveness in the 1970's. G. K. Smith, Rand Working Note - February 1979

The Defense Systems Management College has prepared a more detailed list of material available to the Task Force. The document is an author and title index and was prepared by the Information Services Center, Defense Systems Management College, Fort Belvoir, Virginia.